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Foodways and a Violent Landscape: A Comparative Study of Oneota and Langford Human-Animal-Environmental Relationships

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FOODWAYS AND A VIOLENT LANDSCAPE: A COMPARATIVE STUDY OF ONEOTA AND LANGFORD HUMAN-ANIMAL-ENVIRONMENTAL RELATIONSHIPS

by

Rachel C. McTavish

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ABSTRACT:

FOODWAYS AND A VIOLENT LANDSCAPE: A COMPARATIVE STUDY OF ONEOTA AND LANGFORD HUMAN-ANIMAL-ENVIRONMENTAL RELATIONSHIPS

by

Rachel C. McTavish

The University of Wisconsin-Milwaukee, 2019
Under the Supervision of Robert Jeske

The goal of this research is to investigate the nature of Upper Mississippian human-animal-environmental relationships (circa AD 1050-1450), to evaluate the role of resource management, the role of sustainability, and the multi-faceted nature of human-animal relationships, to understand how these choices are related to adaptations to structural violence. The research uses the Koshkonong Locality of southeastern Wisconsin and the Fox/Des Plaines Locality as case studies to compare divergent Upper Mississippian practices within the northern Prairie Peninsula.

This study uses zooarchaeological vertebrate and invertebrate data. Inclusive zooarchaeological datasets provided useful information about basic dietary trends, ecological management systems, environmental niche exploitation, and non-economic human-animal relationships.

The Oneota and Langford groups occupying the Lake Koshkonong and Fox/Des Plaines localities were likely responding to structural violence and the threat of potential physical violence within their daily resource choices. However, they show different cultural choices in the more nuanced manners in which they responded to systemic violence. These nuances can be connected to the divergent perspectives on placemaking and longevity on the landscape and the connections between choices in sustainability and management of local resources.

Overall, this dissertation research has called into question and provided a case for the re-evaluation of previous site typological assumptions and how groups settling within a “locality” interact in a socio-economic and political manner. While previous researchers have classified and analyzed the Robinson Reserve and Schmeling sites as villages, the inclusion of more data and a larger understanding with more village sites excavated in these localities allows for their re-interpretation as mortuary sites. In re-labeling the Robinson Reserve and Schmeling sites as having a mortuary function rather than a daily village life function, the demographic served in these specific locations on the landscape is shifted. This shift is necessary for the interpretation of the faunal assemblages, but more so it shifts the overarching ideas of what sites are located within these localities, what types of sites one can expect to find in future surveys and excavations. The intra-locality subsistence data and inter-cultural subsistence data indicates the value for a nuanced approach is necessary for testing how a group or groups’ daily choices are affected by the threat of systemic violence.

These two veins of research allows for future discussion of what is involved in Late Prehistoric groups’ decisions and concepts of placemaking- placemaking as marked by the surfaces used by the living, by the dead, and when those places are made and intertwined by both. Most importantly, the challenge to previous site typologies and the more nuanced examination of intra locality and inter-cultural subsistence data shifts the way in which we interpret the human-environmental relationship for groups in the region.

For my family.

And in memory of Kelsey, Sharonda and Maria.

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1. Introduction

The focus of this dissertation is the exploration of systemic violence and environmental, social, political, and religious regime shifts in the Prairie Peninsula during the Late Prehistoric (circa A.D. 900-1600). The Prairie Peninsula and Western Great Lakes regions show significant cultural and environmental changes during this period (e.g., Baerreis and Bryson 1965; Baerreis et al. 1976; Griffin 1937, 1960; Jeske 1990; Springer et al. 1982).

Previous research focusing on these cultural and environmental shifts have incorporated inter-group conflict to varying degrees (e.g. Brown 1982; Blitz 1993; Emerson 1999; Jeske 1989, 2002; Lambert 2002; Milner 1995, 1999; Milner et al. 2013; Smith and Cowan 2003; Stoltman 2000). Much of the current literature has focused on the effects of warfare in relation to nutritional stress, bodily trauma, and mortuary patterns (e.g., Emerson 1999; Lambert 2002; Milner 1995, 1999; Milner et al. 2013; Stoltman 2000). Many of these studies have emphasized the evidence for violence on the landscape. In this project, the material results of systematic violence from a zooarchaeological perspective are examined. The daily lifeways of groups engaged with, or threatened by, conflict is looked at with expectations that conflict will leave archaeologically identifiable evidence in the resources targeted and consumed. The relationship between food production and increased violence on the landscape are not necessarily a linear cause-effect relationship (Keeley 1996) but are an entangled series of nested feedback loops (e.g., Arkush et al. 2005; J. Arnold 1996; Dietler and Hayden 2010; Edwards and Jeske 2018; Fabinyi et al. 2014; Hayden 1990; Keeley 1996; Milner 1995).

To investigate possible adaptations to conflict in a nuanced manner, different approaches to understanding the relationship between violence, faunal use, and spatial patterning are considered, including Optimal Foraging Theory, conflict theories and risk management.

Two related, but culturally divergent, archaeological cultures are focused upon in this dissertation--the Eastern Wisconsin Oneota occupation of the Koshkonong Locality and the Langford occupation of the Fox/Des Plaines Locality. Their everyday adaptations to inter-group conflict during the Upper Mississippian occupation of southeastern Wisconsin and Northern Illinois (circa AD 1050-1400), is examined through their use of animal resources and their spatial use of the landscape.

Evaluating Inter-Group Violence, Territorial Conscription and Risk Management

Overall, there is evidence for increased violence on the landscape during the Late Prehistoric in the Western Great Lakes and northern Prairie Peninsula. In this dissertation, a case is built for violence and its effects on Langford and Eastern Wisconsin Oneota groups. It is significant to evaluate the evidence and expectations that these groups were living in a framework of inter-group violence. As groups began to rely more heavily on agriculture, they were increasingly tethered to a particular area on the landscape (Hart 1990, 1993; Marston 2011). The defense of these fields and the associated villages become more critical as groups become increasingly territorial and circumscribed to the landscape (see Layton and Ucko 2003; Zedeño 1997; Zedeño et al. 1997). The degree to which this increasing territoriality and circumscription materialized archaeologically in subsistence strategies were materialized archaeologically for Langford and Wisconsin Oneota groups are discussed.

This investigation is warranted as individuals at Wisconsin Oneota and Langford sites exhibit evidence of trauma and violent death (Brown 1965; Emerson et al. 2010; Emerson and Emerson 2015; Foley Winkler 2012; Fowler 1949,1952; Jeske 2014; Jeske and Sterner 2016; Karsten 2015; Langford 1927; McTavish and Jeske n.d.; Strezewski 2006). These deaths are probably due to systemic raiding and/or other forms of intergroup conflict. If violence, or the threat of violence, played a role in daily life, it likely affected how groups settled on the landscape, procured resources, and interacted with or avoided their neighbors (Childe 1941; Galtung 1969; Fry and Söderberg 2013; Haas and Piscitelli 2013; Lambert 2002; Milner 1992; Parker Pearson 2005).

The theoretical framework of inter-group and village-based violence has been previously applied to archaeological investigations in the Prairie Peninsula (e.g., Emerson 1999; Emerson et al. 2010; Harn 1980; Jeske 1989; Milner 1995, 1999, 2007; Milner et al. 1991; VanDerwarker and Wilson 2016). In this framework, violence is not necessarily simply direct action, but includes activities related to preparation for offensive and defensive tactics between attacks. For example, aside from injury and deaths that directly impact family and corporate structures, small-scale but consistent raids on settlements and retaliations takes human resources away from economically productive behaviors at steady and corrosive levels (Gardner and Heider 1969; Keeley 1996; Maschner and Reedy-Maschner 1998; Milner et al. 1991). Just as importantly, the threat of violence can constrict group settlement choices and restrict access to economic or other important resources (Milner et al. 1991). Given human osteological evidence for the scale of violence, a series of expectations for socio-cultural adaptations for risk reduction in Langford and Wisconsin Oneota groups are generated and tested.

For this dissertation research, subsistence expectations are based on an optimal foraging theory (OFT) approach. It has been well established in the literature as a useful approach when framing arguments regarding resource choice and utilization strategies (Bird and O'Connell 2006; Broughton and Bayham 2003; McGuire et al. 2007). OFT models must be contextualized to gain an accurate model of the time and place under study. In this case, in addition to accounting for a caloric input-output scenario, the Langford and Oneota groups occupying the region had to account for violence as a variable. Therefore, a modified series of optimization for resource choice, procurement, and processing was created.

Optimization of resources can be attained through simple diversification or intensification of energy expenditure, but it can also be attained through other strategies (e.g., relocation, reallocation of labor, refocusing on resource emphasis). Given the social and ecological environmental contexts of Langford groups one can expect that they would opt for resources that meet an alternative form of optimization. Three potential optimal resource characteristics and behaviors loosely based on revised applications of OFT models are proposed for this research.

1) Optimal resources are those relatively close to the habitation site to minimize risk of venturing too far out of a designated safe zone.
2) Optimal resources serve multiple functions (e.g., hides or furs, dense bones for tool manufacture, high-yields of grease or marrow for additional caloric intake).
3) Optimal resources are found where other subsistence or resource acquisition activities occur (e.g., near crop tending, clay resources, chert quarries).

Socio-political pressures from systemic violence are not the only form of pressure within the region. Environmental changes may also have affected the risk management strategies that groups engaged. Edwards (2017) used macro-botanical and bone isotope chemistry to evaluate the risk-management strategies for two sites in the Lake Koshkonong Locality. This dissertation complements Edwards's (2017) model-testing and provides new lines of evidence from both the Lake Koshkonong and Fox/Des Plains Localities.

Zooarchaeological data are integrated to examine a series of nested research questions. These data are compared with previous lithic, floral, isotopic chemistry, ceramic, and human skeletal research. The immediate ecological catchment models (from chapter 4) for the study sites helps to contextualize these multiple lines of evidence and aids in the assessment of resource acquisition choices. Data will be used to explore how subsistence-settlement choices were implemented to alleviate the potential risk of violence from outside groups.

Dissertation Research Goals

The following nested research questions are the overarching focus of this dissertation research. While the main lines of evidence for answering these questions comes from zooarchaeological and spatial modeling data, all questions will be interpreted using a holistic anthropological approach. Evidence from previous and ongoing research in the regions is used (e.g., paleobotantical, bone chemistry isotopes, lithic assemblage and microware, ceramic morphology and design; copper manufacture and design).

1. Do the diets of Oneota and Langford groups in the Lake Koshkonong and Fox/Des Plaines localities support the notion that there was systemic violence on the landscape?
2. What is the nature of the relationship between site type and faunal remains in the Lake Koshkonong and Fox/Des Plaines localities?
3. What is the nature of the human-animal-environmental relationship for Oneota and Langford groups in the Lake Koshkonong and Fox/Des Plaines localities?

The data collection required to address these nested research questions resulted in a comparable dataset that can be used in future analyses. Further, it provides the first comprehensive zooarchaeological dataset for the Lake Koshkonong and Des Plaines localities.

Organization of this Dissertation

The dissertation is organized to first provide readers with contextual and theoretical background to the research topics.

Chapter 2 provides a discussion of the theoretical considerations of the research. It discusses the concept of violence and warfare among and between groups, how groups attempt to navigate a violent landscape, connections between OFT models and violence as a contributing factor for resource acquisition, the connection between the physical landscape and habitation settlement expectations within a violent landscape. The chapter ends with a theoretical model of modified OFT expectations for Lake Koshkonong Oneota and Langford subsistence given the respective socio-political and ecological settings. These modified expectations are used to evaluate the degree to which the faunal data supports the notion of systemic violence.

Chapter 3 presents the culture history of the study region and the general background of Langford and Wisconsin Oneota research. Chapter 4 summarizes the history of archaeological investigations at the five primary study sites.

Chapter 5 provides a discussion of the methods used in the data collection and analysis. Zooarchaeological techniques and quantitative metrics are discussed. The methods and results of an actualistic study to determine potential differences in taphonomic processes and flint-knapping use of white-tailed deer antler are presented

Chapter 6 is dedicated to the vertebrate and invertebrate remains identified in the Lake Koshkonong and Fox/Des Plains Localities. Chapter 7 provides analysis of the data and discusses its implications for the research questions suggests potential future avenues for continued research and concludes the dissertation.

2. Theoretical Framework

This dissertation uses two theoretical perspectives—conflict theory and Optimal Foraging Theory (OFT)—to create a series of research expectations for interpreting the archaeological samples. Conflict theory, and expectations for how groups behave in situations of systemic violence is used as an overarching theoretical paradigm. This paradigm frames the landscape and resource models developed for the subsistence-settlement analysis and determining the choice of methods. Traditional optimal foraging expectations and interpretations were about cost-benefit ratios, often measured in kilo-calories of food consumed and the energy expended to acquire it (see Pyke 1984; Pyke and Pulliam 1977; Smith and Moss 1983). The proposed modifications to OFT expectations used in this dissertation consider the hypothesis of a violent landscape and socio-political environment, which would have fundamentally affected the human-animal-environmental relationship in daily life.

There have been investigations of why humans are violent since the written record, and anthropology has a long and complex literature on the origins and causes of violence and warfare. One specific aspect of that literature, the application of village-based conflict and how it can be integrated into the daily lifeways of people.

Peace and Violence

Peace and violence have nuanced and non-rational behavioral realities that need to be defined for this project. However, it is important to recognize that peace and violence are complicated and often culturally-specific concepts. They can be thought of as two ends of a larger behavioral and socio-political spectrum. Further, there is a broad spectrum of behaviors and conditions that constitute peace and violence. There is the traditional dichotomy of harmony and cooperation versus competition (e.g., Barash and Webel 2017; Bonta 1997; Imbusch 2003).

There is also competition, symbolic hostility, geographic exclusion, and physical confrontation (e.g., Balandier 1986; Ball-Rokeach 1980; Bonta 1997; Coser 1966; Imbusch 2003). Physical confrontation can run the gamut from interpersonal violence to multi-person conflict. Multi-person conflict can occur between groups or among groups within a village, tribe, culture, nation, etc. These may consist of isolated attacks, sporadic clashes, organized and planned attacks (Barash and Webel 2017; Barnes 2017; Galtung 1969; Imbusch 2003; Labigne and Sassauer 2012; Martin and Frayer 1997). Often, the exact classification of the violence or a violent action, or series of actions can be difficult and can be subject to inter-researcher perspective and is culturally specific. The effects, physical, mental, cultural, can be seen in risk management strategies employed by particular groups as both direct and indirect responses to conflict, or perceived risk of conflict (e.g., Arkush and Stanish 2005; Barber 2012; Bates et al. 2002; Chang et al. 2012; Collier et al. 2008; Feldman and Stenner 1997; Flint et al. 2009; Galtung 1990; Huddy et al. 2007; Otterbein 1970, 1999, 2011; Schlight 1990; Shackel 2003; Singh 1976; Smith et al. 2003; Whitehead 2004).

Peace may be defined as the absence of violence or the threat of violence (Galtung 1969; Kurtz and Trupin 1999). As such, peace can be marked between times of conflict. Peace is often described as primarily cognitive in nature, a state of mind or state of being that is absent from conflict or competition (e.g., Galtung 1969; Otterbein 1970). If peace is primarily defined as cognitive state of being, then it is often difficult to ascertain for an outside analyst. However, behaviors that mitigate the risk of conflict, essentially designed with the goal of preserving peace, may be discerned (Ewers 1975; Huddy et al. 2007; Otterbein 1970; Singh 1976). These risk-management behaviors are often inscribed into the underpinnings of a group’s daily structure, such as increased social isolation and reduced territorial exploitation (Feldman and

Stenner 1997; Flint et al. 2009; Gordon and Arian 2001; King and Wheelock 2007; Lekson 2002; McDoom 2012). These behaviors may result in detrimental outcomes that can be measured archaeologically, including reduced health and nutrition, lack of non-local resources, lack of trade items, withdrawal to defensive positions on the landscape, or even evacuation of a long-established homeland (Barash and Webel 2017; Bonta 1997; Coser 1966; Galtung 1969, 1990; Lekson 2002; Lubkemann 2005; McDoom 2012; Turk 2004).

Peace and conflict may also be identified geographically. In times of peace, territories, neighborhoods, or any culturally-defined boundaries between groups should have relatively fluid boundaries. Distinctions between states, nations, empires, resource acquisition sites, would shift depending upon the goals and scope of conflict (e.g., national borders redrawn, transportation routes restructured or under different group's authority) (Arkush and Stanish 2005; Barber 2011; Brunnschweiler and Bulte 2009; Ewers 1975; Flint et al. 2009; Huddy et al. 2007; Hume 2008; Kohler and Alcock 1976; Singh 1976; Whitehead 2004).

During and after conflict, a resulting series of behavioral changes must be created and the sense of normalcy in daily activities is often shifted. These behaviors can be created by or create an overarching doxa. An example of violence, or the threat of violence creating a doxa would be if neighboring groups were killed or had killed members of your group in the past. One then accepts that the neighboring group are an enemy and then act accordingly. As such, a group or individual engaged in conflict likely changes how they act around the opposing group(s) to maintain their stance, avoid particular parties, attempt to de-escalate the conflict, or attempt to escalate the conflict. Daily habits such as where to go, with whom to talk, transportation routes, and/or the shifting of daily priorities, can all be affected. If a conflict is sustained, then these shifted behaviors often become the new normal or a shift in habitus occurs, which can create or be created from a doxa. Without any physical harm occurring to an individual themselves, that person will still act accordingly to avoid a perceived enemy wishing them harm. This doxa of a neighboring group wishing violence or harm is passed down through generations through enculturation.

In the case of territoriality and resource acquisition, one may see groups moving longer distances on the landscape to vacate their previous homeland, a series of ethnic expressions suppressed or modified to assimilate, the eradication of a particular group in the region, and/or a change in the sourcing of trade materials and food resources (Beernet 2000; Conor 1988; Ewers 1975; Keener 1999; Labigne and Nassauer 2012; McDoom 2012; Senaratne 1997; Thomson 2011; Zolberg et al. 1992).

In smaller-scale conflict-based shifts, between times of conflict and peace, groups may travel with more or less territorial restriction. These restrictions do not necessarily need to come from an opposing group’s authority. The desire to minimize the risk of encountering another group may result in the territorial restriction of particular raw material sourcing (e.g., quarry access, transportation routes, agricultural land, hunting territory). This risk minimization is about encountering another inimical or hostile group (Collier et al. 2008; Feldman and Stenner 1997; Flint et al. 2009; Galtung 1990; Huddy et al. 2007; Otterbein 1970). Decisions to minimize the risk of conflict are often ingrained into cultural practices through a doxa (Barash and Webel 2017; Coser 1966; Galtung 1990).

Thomas (1992) expands his previous theories on conflict management to describe how psychologically, groups and individuals will respond to conflict or the threat of conflict, often adapting behaviors to minimize immediate and long-term risk (Table 2.1).

Table 2.1: Temporal Categories

Properties of Theory	**Time Horizon of Theory**	
	Short-Term	**Longer-Term**
Focus	Coping with here and now	Building desirable futures
Context Assumption	Contextual variables are given	Contextual variables are changeable
Goal	Local optimum: best achievable in present situation	Global optimum: excellence
Recommendations	What actions to take in present circumstances	What circumstances to create
Type of Theory	Contingency Theory	Normative (universalistic) theory
Flavor	Pragmatic/Realistic	Idealistic/visionary

Violence and the Archaeological Record

Violence, whether direct or systemic, does not necessarily leave a single or always replicable material signature, but there are commonalities among expected behaviors resulting from violent or threatening living conditions. However, within a given context, the behaviors that stem from the actuality or the threat of systemic violence (e.g., terror threats, raids, vandalism, consistent harassment) can lead to a set of learned cultural behaviors.

Such behaviors, whether they are doxa or shifts in activities based on new threats, may be linked to models regarding risk management and risk buffering, which have long been adopted by archaeologists engaging in different Optimal Foraging Models. Such behaviors may include, but not limited to, the following:

1) Staying in relatively close proximity to a centrally populated area/habitation site
2) Settling close to family, kin groups, and/or people of your same set of backgrounds/culture
3) Settling in an area that is as safe as possible for a given set of cultural norms, beliefs, and available geographic territory
4) Maintaining a safe zone or no-man's land, (see Emerson 1999)

It is important to note that the above set of potential behaviors for risk management strategies of groups under the threat of violence can occur individually, simultaneously, or not at all, depending upon the specific cultural context. These very generalized sets of behavioral examples can be adapted to the archaeological record, using a combination of ethnographic, ethnohistoric, and archaeological data.

Galtung's (1969) typology of violence as a theoretical framework has been used as a heuristic device by archaeologists to explore multiple axes of conflict situations (e.g., Bernbeck 2008; Halling and Seidemann 2017; Lindman 1987; Redfern 2016; Tung et al. 2016; Tyner 2014; Vander Walker and Wilson 2016). Models of direct, indirect, psychological, and physical violence as a heuristic framework allow researchers to better address the nuanced interconnectedness between subsistence-settlement patterns, the material correlates of habitus (see Binford 1962, 1977; Bourdieu 1977), relationships with neighboring groups (e.g., groups defined geographically by individual sites or localities), and different archaeological cultures that show overlapping periods of occupation within a similar defined territory (e.g., Langford and Fisher groups in Northern Illinois). These groups could easily go from friendly allies and trade partners to competing groups within the two-sigma time span of a single radiocarbon assay. This methodological reality of archaeology and equifinality is daunting, but we cannot discount the likelihood and potential for these complicated relationships to remain fluid (e.g., Arkush and Stanish 2005; Carman and Harding 2013; Keeley 1996; Sastre 2008).

Village-Based Conflict

Anthropological Analogies in Theory Building: The Yanomamö

The Yanomamö have been used as a classic anthropological example for testing theoretical models of village-based conflict, also furnishing archaeological analogies (e.g., Chagnon 1988, 1990, 1997; Fauto 2000; Ferguson 1995, 1996, 2001; Harris 1984; Maschner and Reedy-Maschner 1998). The same data sets have been used to support multiple theoretical paradigms, exemplified by the Chagnon-Ferguson debate, which pit Darwinian explanations against materialist approaches to village-conflict studies (Chagnon 1988, 1990, 1997; Ferguson 1997, 2001). Marvin Harris (1984) also proposed a theory regarding the Yanomamö.

Napoleon Chagnon’s arguments for Darwinian explanations are grounded in the concepts of violence and competition central to theories of biological fitness (Chagnon 1988, 1989, 1990). The traditional Darwinian fitness model is sometimes used unmodified but can also be adapted to a model of socio-cultural fitness (see Thorpe 2003). Socio-cultural fitness is based on the concept of enculturation and continuation of a culture, basic lifeways, and/or ethnic traits into the next generation. This socio-cultural fitness model explains conflict-based resistance to foreign cultural characteristics and/or rival groups potentially imposing their cultural lifeways. This framework works well for archaeological case studies where there is well preserved evidence for rival ethnic or cultural groups occupying neighboring territories or for cases of conquest and empire building (e.g., Tung 2007; Quilter 2002).

Chagnon’s (1998) analogy falls apart when attempting to link reproductive success to successful warriors. However, as Thorpe (2003) points out, connections between reproductive and/or socio-political success to violence can also be attributed to the older age of killers within this society. Maschner and Reedy-Maschner (1998:22) use the same data to interpret conflict through the lens of socio-cultural fitness, where the prestige of an individual can be maintained through conflict. In this case study, the prestige that comes from successful raiding is just as important as the ability to produce more viable offspring.

Marvin Harris (1984) directly critiqued Chagnon about motivations behind Yanomamö warfare. His hypothesis is based on the concept that as village populations increase, the immediately available game animals are easily depleted. As protein sources become depressed, inter and intra-group conflicts occur. These conflicts can result in village fission and hostile groups creating buffer zones between habitation areas. These no-man's lands between groups would allow for wild game to repopulate. This perspective is easily applied to archaeologists studying site-settlement patterns for a region incorporating ecological modeling, subsistence data, and conflict studies (e.g., Kohler and Varien 2012; Rice and LeBlanc 2001; Thurston 2006).

Brian Ferguson's materialist model adopts the principle that conflict arises due to a competition for resources (e.g., land, food, water highway access) (Ferguson 1989, 1990a, b, 1992, 1995). Ferguson argues that there is not a realistic rationale for actors to risk life and limb for anything other than alleviating a resource deprivation (Ferguson 1995). Through this narrowed materialist framework, conflict is necessary for "the redistribution of resources, people, and the balance between them and is a direct result of resource stress and overpopulation" (Maschner and Reedy-Maschner 1998:21). This framework is useful for archaeological studies where there is well preserved environmental and skeletal evidence for environmental shifts potentially resulting in nutritional stress (Thorpe 2003). Ferguson (1996) posited that the Yanomamö went to war to obtain and control metal trade goods brought in by Europeans. Since there was a limited amount of metal goods, which were unequally distributed, the uneven influx of metal blades (axes, machetes, knives) the repayment for these goods was given through labor, brides, military assistance, etc. Outright war between groups occurred when there was a perceived opportunity to benefit from the raiding and re-dispersal of these goods from those directly trading with the Europeans (Ferguson 1996). In this revised model, Ferguson (1996) shows that an unequal access to resources (i.e., inter-group conflict, competition for resources) can result in physical violence.

It is important to note that Harris's (1984) game-hypothesis may also factor into archaeological investigations of village conflict between groups. While Ferguson (1996) explains that groups in the Amazon would just move rather than engage in conflict if resource depressions occurred, he assumes that there is somewhere on the landscape that groups can safely relocate. The balance between cultural notions and investments into a sense of permanence on the landscape, the realities of the threat of violence turning into physical violence, and the socio-political and environmental constraints need to be addressed when attempting to investigate these complex relationships for Prehistoric groups.

Modified Approach to Investigating Village Conflict

Archaeological research has indicated that there was a violent landscape for village groups, while maintaining an ethnic or cultural distinction. These groups also possibly chose specific areas on the landscape for resource and defensive advantages (e.g., Bamforth 1994; Haas and Creamer 1993; Keeley 1996). Distinct groups may have coalesced from previously related but geographically separate groups or connected related groups under a cohesive set of risk-mitigation goals.

In line with Thorpe's (2003) call for a more integrated and careful approach to using ethnographic and archaeological analogies in conflict studies, the approach taken in this dissertation incorporates behaviors we expect to see in times of stress that may result from the socio-political environment (e.g., competition with neighboring groups) as well as the physical environment (e.g., resource depression, climate change). This combination of theoretical approaches can serve to interpret the presence or absence of the effect of systemic violence among Late Prehistoric Langford and Wisconsin Oneota communities with regards to their daily lifeways.

This dissertation contextualizes data and keeps the hypothesis-testing derived from the theoretical model to a local archaeological region (e.g., Prairie Peninsula, Eastern Woodlands, Great Lakes). Specifically, the work here does not use the same constraints on Oneota environmental and social landscapes as Ferguson, Harris, and Chagnon used to discuss the Yanomamö. Nonetheless, a modified Economic/Darwinian derived Optimal Foraging Theory perspective can provide a framework for explaining population movement, risk reduction and/or patterns of violence in small scale societies.

Optimal Foraging Theory

Optimal Foraging Theory (OFT) is a biological model derived from mathematical game theory. This model was used to explain and predict the foraging patterns and choices of animals (for a summary, see Pyke 1984). Anthropologists have long since adopted this model as a heuristic framework to explain and interpret the behavioral choices of foraging groups around the world (see: Gremillion 2002; Hawkes and O'Connell 1992; Smith 1983). Archaeologists have used ethnographic, ethnohistoric, and ethnoarchaeological bodies of literature to create analogies using OFT models to interpret non-state level societal subsistence-settlement patterning (e.g., Bird and Bliege Bird 2000; Broughton 2002; Codding et al. 2010; Winterhalder et al. 1999). Smith et al. (1983) review the basic assumptions underwriting OFT models and addresses the critiques of this model as applied to past and present human groups.

> Most foraging models assume that foragers will be selected to behave so as to maximize the net rate of return (of energy or nutrients) per unit foraging time. This assumption seems reasonable under a variety of conditions, including the following: (1) available food energy is in short supply (fitness is energy-limited); (2) specific nutrients are in short supply (fitness is nutrient-limited); (3) time for adaptive nonforaging activities is scarce (fitness is limited by time available for nonforaging activities); or (4) foraging necessarily exposes the forager to greater risks (fitness costs due to predation, accident, climatic stress, etc.) than do nonforaging activities (for further discussion, see Orians 1971; Schoener 1971; Smith 1979; Winterhalder 1981a, 1983b). (Smith 1983:626)

In OFT models, there are basic choice-based categories from which a set of criteria can be selected to frame a hypothesis-testing research inquiry. These categories include diet breadth, patch choice, time allocation, group size, and settlement location (Smith 1983:624). Essentially, the analyst can distinguish a series of hypotheses focusing on the relationship between optimization in food procuring within the context of a general choice-based category (e.g., where to live, how to utilize habitat resources). Multiple categories can be explored and compared using the same dataset. Given the specific cultural context, physical environment, and resource options, expectations can be generated and then tested using a deductive approach. A summary of important variables for each choice category is outlined below (Table 2.2).

Table 2.2. Optimal Foraging Model Categories (adapted from Smith 1983:627)

Decision Category	**Strategic Goal**	**Domain of Choice**	**Cost-Benefit Criteria**	**Major Constraining Variables**
Diet Breadth	Optimal set of resource types to exploit	Which types to harvest, once encountered	Return per unit handling time for each type, overall return on foraging (including search time)	Search and pursuit abilities of forager, encounter rates with high-ranked resources
Diet Breadth with nutrient constraints	Optimal set of resource types to exploit	Which and how many of each prey type to harvest	Minimum cost for meeting nutritional requirements	Nutrient requirements, abundance of prey types, procurement costs
Patch Choice	Optimal array of habitats to exploit	Which set of patches to visit	Average rate of return with patch types and average overall patches (including travel time between patches)	Efficiency ranking of patch types, habitat richness, travel time between patches
Time Allocation	Optimal pattern of time allocated to alternatives (patches, etc.)	Time spent foraging in each alternative	Marginal return rate for each alternative, average return rate for full set	Resource richness, depletion rates for each alternative
Foraging-group size	Formation of optimal-sized groups for foraging	Size of groups to join for foraging under specified conditions	Average per capita rate of return at each group size, marginal cost and gain to joiner or group members	Return-rate curves for each group size under each condition, possibilities for group formation, rules governing division of harvest
Settlement Pattern	Optimal location of home base for foraging efficiency	Settlement location of each foraging unit (individual or family)	Mean travel costs and/or search costs per unit harvest	Spatiotemporal dispersion and predictability of major resources, effects of cooperation and competition

By using OFT models, analysts can work to quantify the likelihood or levels of optimization regarding resource procurement and utilization by foraging groups (Bird and Bliege Bird 2000; Bright et al. 2002; Broughton 2002; Codding et al. 2010; Gremillion 2002; Hawks and O'Connell 1992; Smith 1983; Smith et al. 1993). OFT models, and behavioral ecology approaches more broadly, are well established theoretical frameworks in archaeology (e.g., Broughton 2002; Codding et al. 2010; Munro 2004; Winterhalder 1981; Winterhalder et al. 1999).

OFT models have been critiqued for their tendency to link human behavior to a deterministic model of strategic subsistence decisions, whereas human actors in real life situations cannot be counted on to make wholly rational decisions (Gremillion 2002; Smith et al. 1983. In fact, these models are best used as heuristic devices for hypothesis-testing rather than as blanket generalizations of individual actor behavior. Humans make food choices based on more than caloric or dietary optimality, including taste, convenience, other uses (see Mintz et al. 2002).

The broad OFT categories selected for individual archaeological case studies vary depending on specific contextual parameters. As such, respective socio-political environments on the landscape must be accounted for, in addition to the location of environmental patches in relation to settlements. In the case of a violent socio-political situation, actors face additional realities that are not necessarily accounted for in the choice-categories outlined in traditional views of OFT.

OFT Criteria Modifications for Groups Under Threat of Violence

It has long been recognized that under conditions of population growth, foraging groups tend to fission into multiple smaller groups rather than increase group size (Birdsell 1958). Over time, if groups continue to fission and they face some constraint on out-migrating, some groups will be unable to use the landscape fully, losing access to resources (Vierra 1982:170). Vierra (1982:170) termed this situation "regional packing" and argued that under these circumstances, mobile groups will opt to reorganize according to Binford's (1980) model of logistical mobility, situating a base camp or village near aggregated or critical resources to avoid conflict with neighbors.

Cultivation and agriculture may be thought of as purposeful aggregation of resources. Even with the potential to reorganize and operate within smaller territories, it is easy to envision that some groups may lose access to necessary resources and resort to militant activity to obtain what they need from their neighbors. In a regional packing scenario, we may expect groups located near aggregated resources or agriculturally productive land to engage in defensive measures even when they are not under active hostile action. For example, we may expect populations to stay close to home and obtain local resources within the immediate or safe vicinity from the habitation site (e.g., Maschner 1997; Nolan 2003).

However, extreme territorial restriction is likely a relatively short-term solution because it may lead to a local resource depression, which would be unsustainable for village populations (Broughton 2002; Cannon 2000; Codding and Bird 2015; Fisher and Valentine 2013). Even for agricultural groups, a few poor consecutive harvests may lead to catastrophic consequences. For territorial restriction to be a viable strategy, it may be necessary to employ a diversification strategy to prolong energy acquisition and stave off local resource depression. To be observable in the archaeological record, this pattern of restriction and diversification in food choices must be long term. Several factors will obscure relatively short-term subsistence shifts, including but not limited to, taphonomy, equifinality, and temporal overlap in radiocarbon assays.

OFT Expectations for Groups Responding to Territorial Conscription

Optimization of resources can also be attained through means other than simple diversification or intensification of energy expenditure. Three potential optimal resource characteristics and behaviors loosely based on revised applications of OFT models can be used.

1. Optimal resources are those within relatively close proximity to the habitation site to minimize risk of venturing too far out of a designated safe zone.
2. Optimal resources serve multiple functions (e.g., hides or furs, dense bones for tool manufacture, significant amounts of grease or marrow for additional caloric intake).
3. Optimal resources are found where other subsistence or resource acquisition activities occur (e.g., near crop tending, clay resources, chert quarries).

These expectations are aimed to consider multiple lines of evidence to evaluate each respective faunal assemblage in each site, archaeological culture, and region.

Summary

Two main theoretical paradigms, village-based violence and optimal foraging theory are used to frame a series of research expectations for interpreting archaeological data from early agricultural sites. Using these models as a combined heuristic framework, the landscape and resource models used in the subsistence-settlement analysis are interpreted through an anthropologically holistic perspective. A modification to traditional optimal foraging expectations for the faunal analysis was created using an expectation of regional conflict. Thus, foraging for game can be modeled with an emphasis on risk management, where a key risk is that of being attacked by a neighboring group. This model can be applied to Langford and Oneota agricultural populations of the 12th-15the centuries in the Prairie Peninsula.

3. Culture History

Upper Mississippian

Upper Mississippian is a taxonomic category that includes a broad geographic and range of distinct archaeological cultures (Figure 3.1). The relationship of these archaeological cultures to actual cultures and ethnicity is debatable (see Binford 1969, 1970, 1977; Jones 2002). Cultural traditions include: Oneota Tradition, Langford Tradition, Fort Ancient Tradition, and Oliver Phase (Brown and O'Brien 1990; Cook 2007; Emerson 1999; Gibbon 1970, 1972; Griffin 1943; Hall 1962; Jeske 1989, 1992, 2003; Schneider 2015) (Table 3.1). Temporally and spatially, Upper Mississippian material culture overlaps with both Late Woodland and Middle Mississippian Traditions (Cook 2007; Droessler 1981; Emerson et al. 2000; Essenpreis 1978; Hart 1999; Kelly 1990; Smith 2014; Yerkes 1988). This overlap occurs circa AD 1000 and continues for as much as 200-300 years (Brown and O'Brein 1990; Emerson 1999; Jeske 1989, 2000; Jeske and Sterner 2016). These traditions are separated archaeologically based on material culture, and inferred social complexity, subsistence economics, and mortuary programs. It is important to note that some researchers debate the inclusion or separation between Oneota and Langford (cf. Barres 2001; Jeske 2003), but for the purposes of this dissertation they are treated as related but discrete cultural entities.

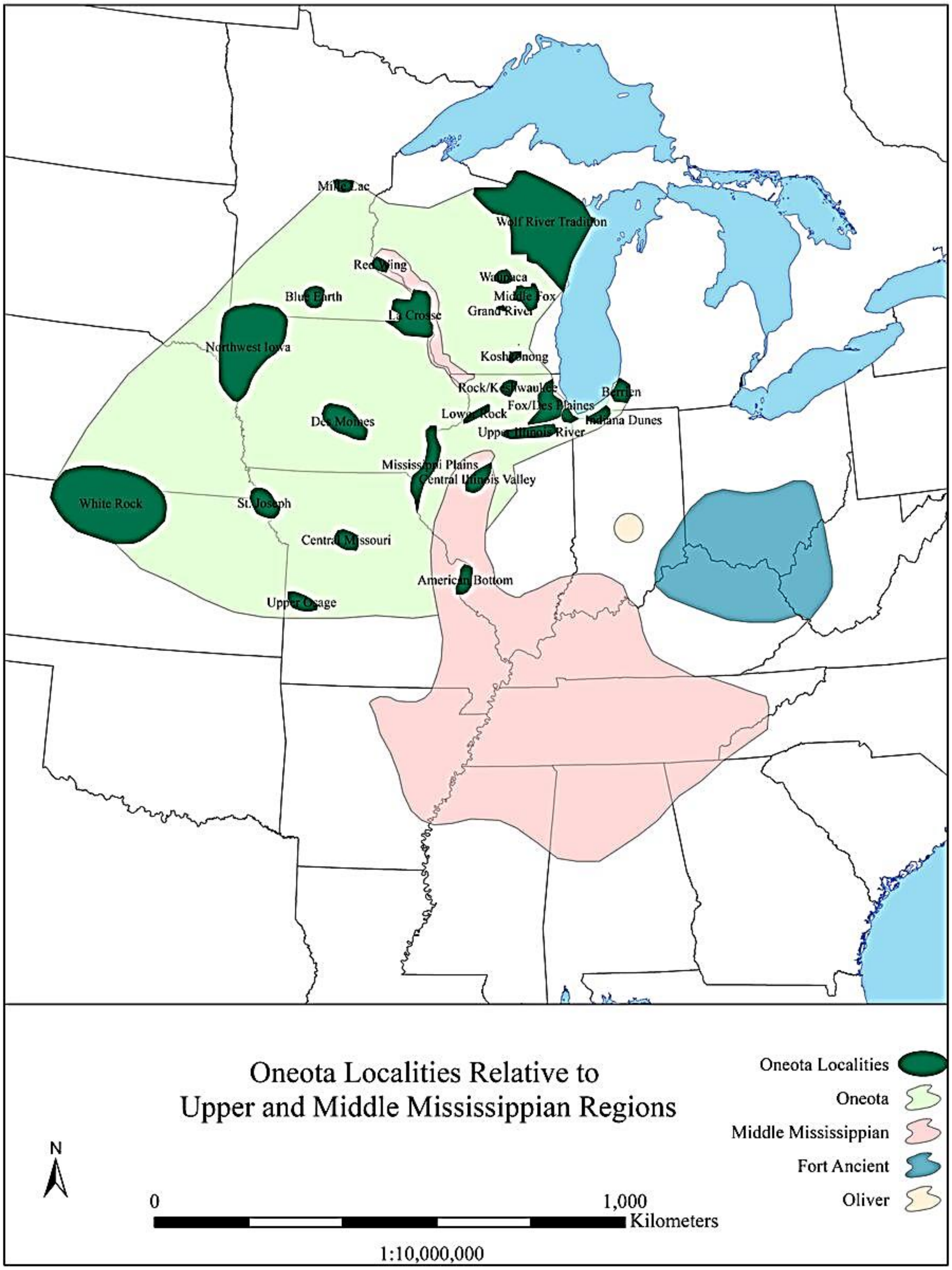


Figure 3.1. Upper Mississippian Traditions in Relation to Oneota and Langford Groups.

Table 3.1. Upper Mississippian Traditions in Midcontinent

Upper Mississippian Traditions		
Tradition	**Dates**	**Citations**
Oneota	AD 1000-1650	Hall 1962; Overstreet 1997
Langford	AD 1000-1450	Brown 1961; Jeske 2000
Fort Ancient	AD 1000-1650	Cook 2007
Oliver	AD 1400-1650	McCullough 2000

In Wisconsin and northern Illinois, Late Woodland groups occupied the region circa AD 400-1300 (Clauter 2002; Goldstein and Richards 1991; Richards and Jeske 2002). They are associated with small village occupations, a shift from hunter-gatherer-foraging to early horticulture and food production, an increase in sedentism, and mortuary interments within mounds (Emerson et al. 2000; Gartner 1999; Hart 1999; Richards 1992; Storck 1974; Theler and Boszhardt 2000). In southern Wisconsin specifically, the building of effigy mounds that were not always used for mortuary purposes is prevalent (Birmingham and Eisenberg; Hurley 1975; Rowe 1956).

The differentiation between Late Woodland groups and Mississippian groups is generally seen through ceramic production. Late Woodland groups used grit-temper, while Mississippians primarily used shell temper and shift to more globular jars through time (Clauter 2002; Farnsworth et al. 1991; Fortier and Griffin 1976; McElrath 2002; Goldstein and Richards 1991; Hall 1962; Jeske 1990; Milner 1990; Schneider 2015). A notable exception is the Langford Tradition in northeastern Illinois. Langford groups also used Oneota-like design motifs but used a fine mafic mineral, gabbro, for temper. The tabular gabbro allowed for thin ceramic walls similar to shell tempered ceramics, (Brown 1961; Brown et al. 1968; Emerson and Emerson 2015; Fowler 1949; Hall 1962; Jeske 1989, 2003; Langford 1929). Langford groups, while within a separate archaeological category than Oneota, are classified as an Upper Mississippian group (Brown and O’Brien 1990; Early 1974; Emerson 1999; Emerson et al. 2010; Emerson et al. 2017; Jeske 1989, 1990, 2003). Langford geographic distribution is essentially northeastern Illinois, with a few outliers, and this region is surrounded by multiple shell-tempered using groups—Middle Mississippians to the south, Oneota groups to the north and west.

Middle Mississippian archaeological culture is seen as a divergence from previous Late Woodland lifeways. This divergence manifested differently in socio-political organization, material culture use, burial practices, and subsistence economics from Upper Mississippian groups (Brown and O’Brien 1990; Emerson 1999; Emerson et al. 2005; Emerson et al. 2000; Jeske 1990, 2003; Kelly 1990; Smith 2014; Yerkes 1988). Middle Mississippian sites show evidence of a stricter social stratification, represented by architectural structure and organization, and mortuary activities including elaborate grave goods, cache offerings of exotic materials, and internments within burial mounds (Brown and O’Brien 1990; Hall 1962; Jeske 1990; Schneider 2015). Additionally, there is evidence of a dramatic increase in food production and reliance on maize agriculture at the expense of exploiting wild food sources (see Emerson 1999, Emerson et al. 2005; Pauketat 2004; Pauketat and Emerson 1997; Milner 1998).

In contrast, Upper Mississippian groups are generally seen as highly diverse in their reliance on maize cultivation, settlement types, mortuary patterns, and the different degrees of direct and indirect influence from Cahokia (Brown and O’Brien 1990, 1967; Early 1974; Emerson et al. 2005; Emerson and Emerson 2015; Foley 2012; Hall 1962; Jeske 1990; Jeske and Sterner Miller 2015; Schneider 2015). Fort Ancient and Oliver Phase sites do appear to have had closer ties (e.g., similarities in site layout, societal hierarchical embodiment, ceramic motifs) to Cahokia and Middle Mississippian sites (Cook 2007; Cook and Fargher 2007; Comstock 2017; Schulenburg 2012). Oneota and Langford villages were much smaller than Middle Mississippian villages, with less organization in hierarchical site structure such as central plazas and pyramid mounds for elite residences and burials (Brown and O'Brien 1990; Early 1974; Emerson 1999; Jeske 1989, 1990, 2003).

Oneota Tradition

Charles Keyes (1927) coined the term Oneota to describe shell-tempered ceramics from sites along the Upper Iowa River in northeastern Iowa. Oneota was further defined under the Midwest Taxonomic Method as a part of the Upper Mississippian Phase (Griffin 1966; Hall 1962; McKern 1945). The term Oneota has been used since to classify archaeological sites in the western Great Lakes and Plains regions within the Midcontinent (Benchley et al. 1997; Brown and Sasso 2001; Buikstra and Milner 1991; Green 1995; Hart 1990; Henning 1998; Overstreet 1997; Ritterbush and Logan; Sasso 2003). It is important to note that since Keyes and McKern first applied the term Oneota to archaeological sites, the term has become so broad that is has very limited utility, similar to the term Celtic among Old World archaeologists.

In Wisconsin, there are different Oneota manifestations, generally divided into two larger regions: eastern and western Wisconsin (see Schneider 2015). These manifestations are related but divergent, and within each half of the state, there is variation within each locality (Boszhardt 1994; Edwards et al. 2017; Jeske and Edwards 2015; Jeske and Sterner 2016; Overstreet 1997; Schneider 2015; Sterner 2012, 2017; Theler and Boszhardt 2000, 2006) (Figure 3.2).

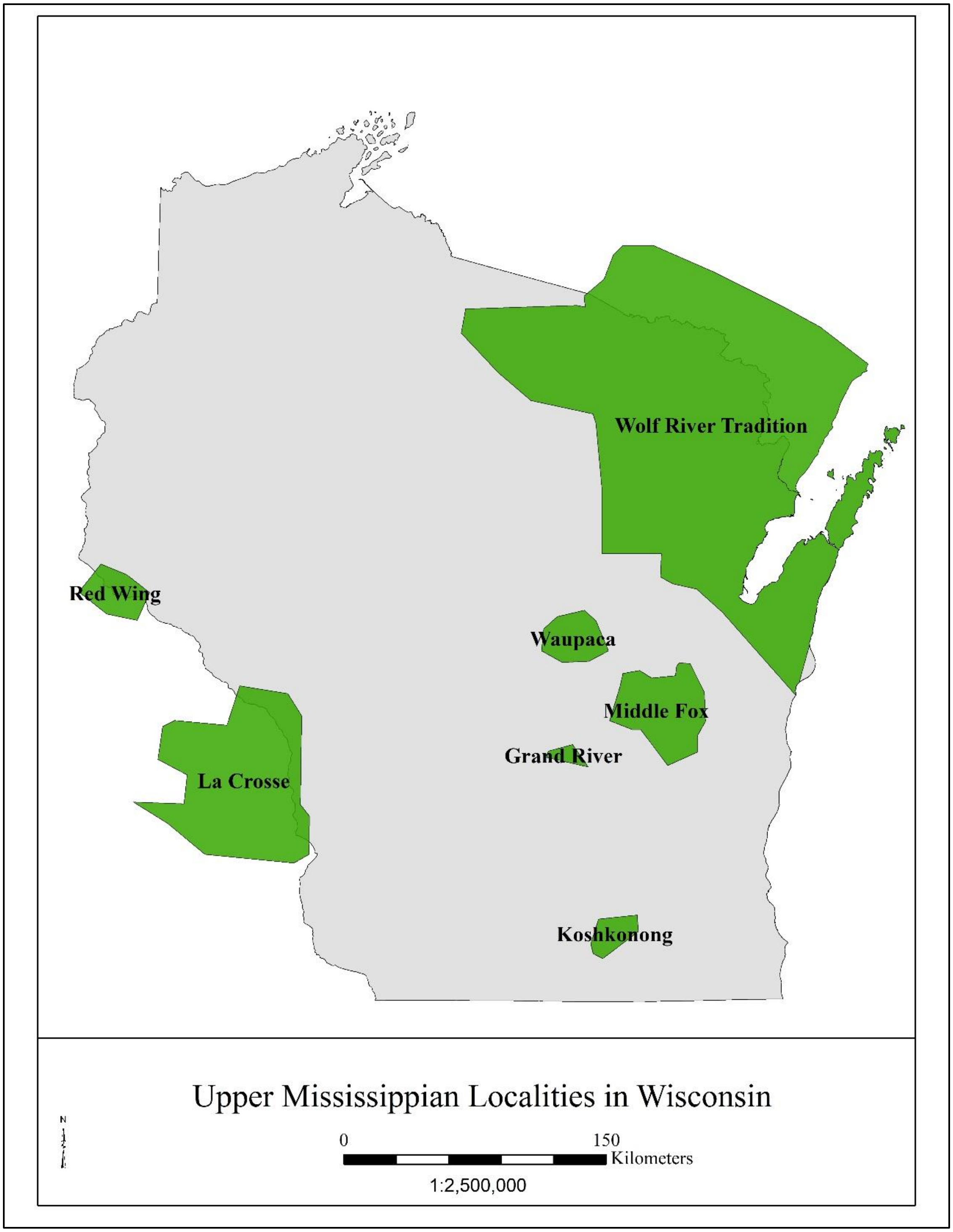


Figure 3.2. Upper and Middle Mississippian Culture Areas in Wisconsin

Oneota Chronology in Wisconsin

Robert Hall (1962) used ceramic correlations and radiocarbon dates to propose a chronology for the Oneota Tradition in Wisconsin (1962:106). The three horizons were: Emergent, Developmental, and Classic. Overstreet (1997) included a later Historic horizon to Hall's chronology (Table 3.2). The horizon concept has been a matter of debate (see Brown and Sasso 2001; Boszhardt 1997, 2004; Henning 1998; Tiffany 1982, 1997, 1998; Overstreet 2001). Recent excavations providing new information on radiocarbon chronology, house forms, ceramics, and lithics show that these chronologies are not readily applicable to eastern Wisconsin (see Edwards 2017; Schneider 2015; Sterner and Jeske 2017). Radiocarbon data at Lake Koshkonong sites show that the area was occupied beginning as early as AD 1050-100 and continued until circa 1430.

Ceramics have been the primary, and original, form of material culture used to define temporal horizons and regional phases within the Oneota Tradition. Stylistic and manufacture changes in ceramic production are often used to determine variations within regions as well as temporal shifts to infer technological changes and the movement of peoples (Boszhardt 1994; Brown and Sasso 2001; Hall 1962; Schneider 2015). However, Schneider's (2015) ceramic data did not support Boszhardt and McCarthy (1999)'s model, as the ceramic production types were too different within and between localities and did not match the radiocarbon distribution seen in the LaCrosse locality and the Mississippi River Valley.

Schneider shows that ceramics from Oneota localities of Lake Koshkonong, Tomorrow River, and Green Lake demonstrate largely isolated groups with some interaction, with significant variations in motif and local production—not groups sharing a single set of ideas for ceramic design and production.

Similarly, Sterner demonstrates distinctive technologies for lithic production and use between Lake Koshkonong and LaCrosse, which does not support a horizon concept. This framework of using artifact typologies to correlate with large distinct cultural changes among Oneota groups has also been conducted using a point-scraper index based in LaCrosse, Wisconsin, which has been expanded into parts of southeastern Minnesota and eastern Iowa (see Boszhardt and McCarthy 1999). Following Hall (1962), Boszhardt and McCarthy (1999) found a correlation between ceramic typologies, point-scraper proportions, and phases/horizons for Oneota sites within the LaCrosse locality. They suggested that Hall was correct in linking the decrease in points to scrapers through time to an increase in bison hunting and change through time.

Sterner (2017) suggested that the differences in the point-scraper index between LaCrosse and Lake Koshkonong is a higher proportion of triangular points rather than fewer scrapers. In her lithic analysis, Sterner (2017) argues that perhaps these differences have less to do with proximity to bison hunting but are instead related in differences in the degree of conflict.

Ceramic Technology

In 1962, Robert Hall proposed several Wisconsin Oneota ceramic types (Figure 3.3) based on ceramic assemblages at the Carcajou Point site. Most of these ceramic types have been used by researchers as a standard typology for Oneota sites within Wisconsin (i.e., Carcajou Curvilinear and Carcajou Plain, Grand River Trailed, Grand River Plain, Koshkonong Bold and Busseyville Grooved Paddle). Recent ceramic analyses using Eastern Wisconsin Oneota sites by Schneider (2015) and Carapax (2017) demonstrate that from A.D. 1050-1400 groups used ceramic manufacture and design motifs to distinguish themselves between respective localities. Schneider (2015) builds a case for pottery manufacture in the Lake Koshkonong locality using grooved paddle surface treatment and design motifs to accentuate their socio-political autonomy from other Oneota localities and other Upper Mississippian groups in the greater Prairie Peninsula (e.g., Fisher, Langford, Fort Ancient, Oliver).

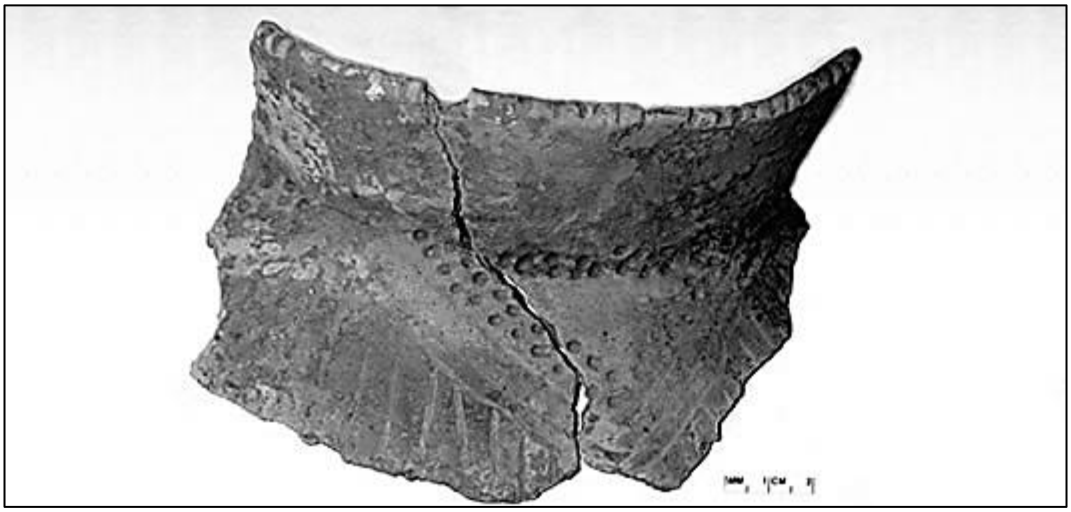


Figure 3.3. Ceramic Sherd from CBHC, adapted from Jeske et al. 2003

Lithic Technology

Oneota chipped stone tool technology includes both formal and likely curated tools and expedient tools. A variety of formal tools are typically found in assemblages, including triangular points (Madison Triangular), scrapers, knives, and drills (Gibbon 1986). Expedient chipped stone tools are often unrefined bifacial and unifacial tools and utilized flakes (Figure 3.4) (Boszhardt 1994; Jeske and Sterner Miller 2015; Sterner and Jeske 2017; Wilson 2016). Such tools are often made using local chert, often of fair or inferior quality (Jeske and Sterner Miller 2015).

Figure 3.4. Madison Triangular Points from KCV site, adapted from Wilson 2016:199, Plate 9

Since Late Woodland and Middle Mississippian groups also utilized local raw materials of varying quality of chert, often with the same or similar formal tool forms, Gibbon (1986) argues that stone tool assemblages are not diagnostic of an Oneota occupation. Groundstone tool technology has not been investigated as thoroughly as chipped stone tools (e.g., Jeske and Sterner Miller 2015; Sterner 2012; Sterner and Jeske 2016). However, there are sometimes manos, metates, and nutting stones that have been recovered (Jeske et al. 2003; Sterner 2012a). Groundstone, as a formal tool, can also be reused as liners for fire rings and is sometimes underreported and classified as fire-cracked-rock (McCullough 2007).

Structure Types

Oneota house types are varied. Although it is thought that early house structures included square wigwam-like structures, rectangular structures, and pit houses (Overstreet 1997:260), later structures are primarily square wigwam-like structures (Overstreet 1997:39-41). At CBHC, there are a minimum of three longhouses with wall trenches and four subrectangular houses with postholes. The longhouses may be younger than the square structures, but there is an overlap in radiocarbon assays (see Jeske and Sterner 2018). Longhouse structures continued through the site history.

Through time, there appears to be slight change regarding house structure types—they remain varied but are predominately square structures. The most notable difference in settlement patterns is the increased size of Oneota villages (O'Gorman 1996; Overstreet 1995, 1997). This increase in settlement size correlates with an increase in reliance on maize horticulture (Edwards 2010; Edwards and Jeske 2013, 2015; Overstreet 1997).

Some Oneota sites exhibit potential ritual deposits within houses or potentially created during house construction. For example, the Crescent Bay Hunt Club site (CBHC) includes an unknown structure type, with post mold angles indicating a circular domed structure, unlike others excavated in the region (Jeske et al. 2016; Sterner and Jeske 2018). The function of the structure is not necessarily ritual, but the absence of refuse within or nearby the structure suggests that this space was perhaps a communal area within the site.

Copper Technology

Copper mining and working was established among prehistoric groups long before the Late Prehistoric (e.g., Ahlrichs 2016; Fogel 1963; Hruska 1967; Pleger 2000; Ritzenthaler 1946; Stoltman 1986; Wittry and Ritzenthaler 1956). Oneota groups primarily used copper similarly to previous Late Woodland groups (Ehrhardt 2009; Jeske and Hunter 2001; Overstreet 1997). Oneota groups used copper for both utilitarian (e.g., awls) and decorative (e.g., beads, pendants) purposes (Overstreet 1997; Pozza 2016). Pozza (2016) showed potential shared ideological characteristics through time at the Lake Koshkonong Locality, aligning some copper artifacts to ceramic motifs.

Hill and Jeske (2011) conducted a temporally and spatially comparative LA-ICP-MS test using Oneota copper artifacts from the Lake Koshkonong Locality. Their preliminary results showed that Oneota occupants of Crescent Bay and Middle Mississippian occupants of Aztalan seem to be exploiting resources in northeastern Wisconsin, near Lake Michigan.

Mortuary Patterns

Mortuary patterns at Oneota sites show great deal of variation in the treatment of the dead within localities (Foley Winkler 2011; Jeske 2015; O'Gorman 1996; Overstreet 1997). Burial patterns include the use of cemeteries separated from habitation areas, intrusive mound burials, interments within villages and house contexts, and isolated remains found within refuse pits-seemingly treated in an analogous manner to faunal remains. Most burials contain relatively few grave goods (Foley 2004, 2008, 2012; Jeske 2015; O'Gorman 1996; Overstreet 1997, 1998). Grave goods were often utilitarian (e.g., lithic points, tools, adornment, pipes). There is limited evidence of deceased persons being cared for or being connected to the subsequent generations. Examples of this connection include secondary burials, disarticulation, and sometimes the rearticulating of remains (O'Gorman 1996). Longhouse burials appear to differ between eastern and western Wisconsin (see O'Gorman 1996; Foley Winkler 2011). In eastern Wisconsin, most longhouse burials contain fewer individuals buried perpendicular to the structure walls (Foley Winkler 2011; Jeske and Sterner 2018). While western Wisconsin longhouse burials contain more individuals with the house structures, not all of which are aligned along a structure wall (Jeske and Sterner 2018; O'Gorman 1996).

Subsistence

Oneota sites show evidence of maize horticulture and/or agriculture to supplement the hunting-gathering-foraging of wild resources (Arzigian 2000; Edwards 2017; Egan-Bruhy 2014;

Theler and Boszhardt 2000, 2006). The exploitation of Eastern Agricultural Complex (EAC) plants is also typical of Oneota groups, even during and after the adoption of maize (Arzigian 2000; Edwards 2017; Egan-Bruhy 2014; Hart 1999; Sasso 1993). The EAC plants common to most Oneota floral assemblages include goosefoot (*Chenopodium*) and sunflower (*Helianthus*), which were exploited by previous and temporally overlapping Late Woodland groups (Brown and Sasso 2001; Edwards 2017; Egan-Bruhy 2014; Hart 1999; Sasso 1993).

Floral analyses, especially in Wisconsin, emphasize the combined use of maize horticulture with the gathering of wild rice (Arzigian 2000; Edwards 2016, 2017; Egan-Bruhy 2014). Arzigian (2000) compared the utilization of wild rice between Woodland and Oneota groups in the LaCrosse region, and found that as maize became a food staple, wild rice consumption decreased, but it did not fully cease. Wild rice gathering occurred along the tributaries near the Mississippi within close proximity of the sites. Egan-Bruhy (2014) and Edwards (2016, 2017) have shown similar patterns of wild rice exploitation alongside maize horticulture for Oneota groups in the Lake Koshkonong locality.

Typical maize horticultural tools for Oneota groups are bison and deer scapula hoes (Theler and Boszhardt 2000, 2006). However, the Lake Koshkonong Locality has no evidence of hoe technology, although digging sticks have been recovered (McTavish et al. 2016; McTavish and Klemmer 2016). Deer and elk scapula have been recovered from Lake Koshkonong sites, but none of these shows evidence for hafting for use as hoes (Edwards and Jeske 2015; McTavish et al. 2016). Jeske (1989) has linked digging stick versus hoe technology to poorly drained lowland soils versus better drained upland soils. The choice of one technology over another is due to where groups are choosing to locate their fields or gardens. The choices may be due to historic traditions, constraints due to fear of violence, physical environmental constraints, or some combination. The subsistence practices related to plant-based resource acquisition are arguably linked to the variety and ecological niche exploitation of faunal resources.

The smaller valleys and terraces overlooking or near smaller rivers, sloughs, and wetlands along which most Oneota villages are located would have provided a safe area to harvest wetland resources. An example is the wild rice harvesting can be conducted during the same time by separate groups (e.g., gendered labor, age cohorts) as well as fishing and shellfishing. Further, wild rice harvesting can be conducted at the same time by separate groups, and fishing and shellfishing can also be conducted, or wild rice harvesting, fishing, and shellfishing can be conducted at the same time by diverse groups. These scenarios are not mutually exclusive, but it is important to note that nested resource procurement could occur simultaneously. Thus, productive ecological niches were engaged with in a variety of ways by different members of the group. In addition to the exploitation of fish and shellfish as subsistence resources, shells were utilized as temper in Oneota pottery.

Oneota zooarchaeological assemblages often demonstrate a modest emphasis on wetland medium mammals, which could have been trapped along the creek and lakeside while groups were engaging in the aforementioned activities (Boszhardt et al. 1984; McTavish et al. 2016; O’Gorman et al. 1995; Theler 2000; Theler and Boszhardt 2006). While the presence of deer and other upland mammals is almost ubiquitous at Oneota sites, the exploitation of upland large mammals differs among Oneota localities (c.f., Theler and Boszhardt 2006; McTavish et al. 2016).

In the LaCrosse Locality, Oneota sites show a trend of emphasizing fishing over hunting for protein resources, evidenced by an overall paucity of large mammal remains, sparse evidence of marrow or bone grease processing, and a lack of variation in deer, elk, and bison elements found at the sites (Boszhardt et al. 1984; O'Gorman 1995; Theler 2000; Theler and Boszhardt 2006). Boszhardt and Theler (2006) proposed that this subsistence strategy is the result of seasonality, especially in relation to the Tremaine Complex. Here Oneota groups moved west in late fall and winter, hunting deer, elk, and bison, returning with particular elements (e.g., scapulae for hoes) (Theler and Boszhardt 2006:444, 2000:302-303). LaCrosse is in close proximity to the prairie environments on the plains of Minnesota and Iowa, and it appears that Oneota groups may have been making any one of the following subsistence choices: 1) seasonal migratory rounds to hunt large game on the Plains; 2) exchange or trade pilgrimages to these areas; or 3) hosting exchange events with neighboring groups that had more readily available access to large hunting grounds in other areas of the Mississippi Trench. This hunting strategy is different than southeastern Wisconsin Oneota groups in the Lake Koshkonong Locality.

Oneota sites at Lake Koshkonong have been interpreted as year-round settlements based on paleobotantical evidence for fall agricultural harvests and winter buds (Edwards 2017). Although contemporaneous in radiocarbon years, it is not clear if both CBHC and KCV sites were occupied simultaneously or were occupied sequentially in relatively short chronological intervals (Edwards 2010; Edwards and Jeske 2015; Jeske et al. 2016; Schneider 2015). Sites show evidence of hunting, trapping, and fishing (Agnew et al. 2016; McTavish et al. 2016; Van de Pas et al. 2015).

Given evidence for intergroup conflict and territoriality, it is possible that hunters were forced to harvest younger animals because they were operating within a small hunting range around the habitation area. The harvesting of these young animals before they had a chance to breed may have led to a local resource depression (McTavish et al. 2016). The Crescent Bay Hunt Club site (CBHC) shows a larger dietary variety in diet, probably representative of the diverse suite of animals available year-round and a wider array of animals available (McTavish et al. 2016). Thus, the site occupants did not have to go far to have a varied diet, and if one resource was in jeopardy of depression, a variety of others would have been available to fill the void during the time necessary for ecological replenishment. Nonetheless, dental evidence from Crescent Bay indicate that at least some individuals suffered from malnutrition (Foley Winkler 2004, 2012; Jeske 2014; Jeske and Foley Winkler 2001).

Langford

Langford is a northern Illinois variant of Upper Mississippian archaeological cultures that is related to, but distinct from, Oneota. George Langford (1927) provided the initial discussion of what would later be called the Langford Tradition at Fisher site. Melvin Fowler provided the first published reports on Langford excavations at Robinson Reserve (Fowler 1949, 1952). James Brown published the results of excavations by Willis at the Gentleman Farm site and Orr's work at the Zimmerman sites (Brown 1961, 1990; Brown et al. 1969). However, up until the 1980s, little was known about Langford as an archaeological culture apart from their restriction to Northern Illinois and the use of grit-tempered ceramics with Oneota-like design motifs (Brown 1967, 1990; Early 1974; Emerson et al. 2005; Emerson et al. 2010; Jeske 1989, 1990, 1992, 2000, 2003b).

Birmingham (1976) and Early (1974) attempted to define or create a Langford-type settlement pattern. However, due to the limited number of excavated sites with a true Langford component, these early attempts were limited in their utility. However, since then, a series of excavations and large-scale surveys targeting areas that we now know are Langford localities have led to a regional chronology and understanding of Langford material culture (Brown and O'Brien 1990; Doershuk 1988; Emerson 1999; Emerson et al. 2010; Emerson et al. 2005; Hart and Jeske 1987; Jeske 1986, 1990, 1992, 2003; Jeske and Hart 1988; Lurie 1987, 1992; Lurie and Jeske 1988; Markman 1984).

Langford Chronology and Typology

Bird (1997) attempted to connect a typology and chronology of Langford sites, analogous to Oneota phases and horizons. However, those localities and chronologies did not hold up with additional excavation and artifact analytical research. This dissertation collapses some localities from Bird's previous work (Figure 3.5), although the redefining of what is Langford, if temporal phases should be re-examined are beyond the scope of this dissertation (see Edwards 2017; Emerson and Emerson 2015; Emerson et al. 2005; Jeske 1989, 1992, 2003; McTavish and Jeske n.d.). The localities used in this dissertation are named for the major waterways on which the localities are located:

- Rock/Kishwaukee
- Fox/Des Plaines
- Chicago Lake Plain
- Upper Illinois River Valley

As one moves south in Illinois, Langford sites are not found in tight clusters, as seen in contemporary Oneota groups. However, it is also important to note the ranges of areas where sites are not highly concentrated. The assertion that during the Late Prehistoric, groups aggregated on the landscape and a no man's land was created between localities has been the focus of previous research (e.g., Emerson 1999; Jeske 1989; Edwards 2017).

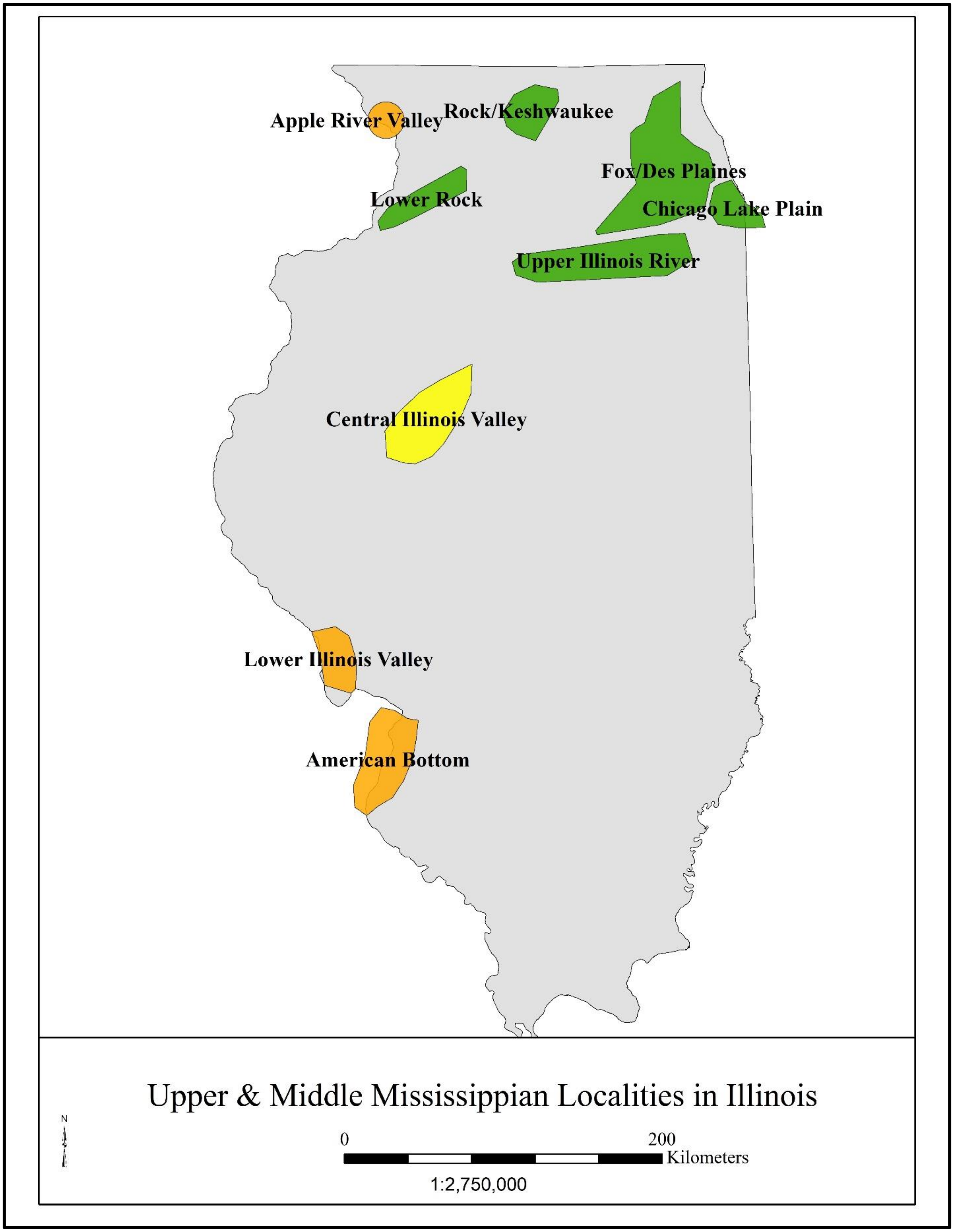


Figure 3.5. Major Late Prehistoric Localities in Illinois

There have been multiple theories proposed as to where Langford groups originated and how they diverged from Late Woodland groups and remained divergent from contemporaneous Oneota groups (see Brown 1965, 1990; Emerson 1999; Jeske 1989). Late Woodland Starved Rock Collared wares and Langford ware body sherds are indistinguishable—the vessel shape and rim forms change.

It is important to note that Langford ceramics appear to be present in the archaeological record before, during, and after contact with Middle Mississippians (Bird 1997; Brown 1967, 1990; Emerson 1999; Emerson and Emerson 2015; Jeske 1989, 1990, 2003). To determine whether Langford and Middle Mississippian groups interacted, Bird (1997) investigated sites that were primarily Langford occupations, but also produced Middle Mississippian artifacts, and tested four theories on how and why Langford groups remained distinct from their Oneota counterparts. The results are briefly summarized below:

Immigration Theory: While there is evidence of a co-occurrence of Langford and Middle Mississippian artifacts at some sites, data does not necessarily suggest that site-unit intrusion affected Langford settlement changes.

Diffusion Theory: While isolated Southern Cult items are noted at sites with Langford and Middle Mississippian groups, there is no evidence of a trait-unit intrusion affecting Langford settlement changes.

Fusion Theory: While presence of Middle Mississippians in northern Illinois and Southern Wisconsin has been established (e.g., Apple River, Spoon River, Aztalan), there is no data to suggest that fusion of a resident Langford culture with migrating Middle Mississippians occurred during an immigration north. Further, there is no data to suggest cultural fusion resulted in new cultural practices or hybridized material culture.

Isolation Theory: While it was possible that contact or interaction with Middle Mississippian social groups and other Upper Mississippian social groups occurred at many sites within Langford settlement systems, data suggest that cultural continuity was not the result of isolation from other groups

Ethnogenesis: Brown (1965) proposed a clinal variation in material culture throughout Prairie Peninsula, arguing that a fragmented Late Woodland population coalesced into associated but separate groups circa AD 1000. Within-group corporateness is evident in archaeologically distinguishable beginnings of Langford settlements. This model was further tested and supported by Jeske (1989, 1990,1992) with case studies of later Langford excavations.

Mediation/Accommodation: White (1991) proposed that blurring of variation in material culture is evident at the boundaries between social groups in possession of Fisher series ceramics and social groups in possession of Langford ceramics. Alternatively, Jeske (1989, 2003) argues that this blurring of boundaries is not evident in Langford vs. Fisher settlement patterns, ceramic traditions, and subsistence practices, as distinct cultural choices are made that differentiate these groups throughout their temporal occupation of northern Illinois.

Langford and Middle Mississippian groups were at least were aware of each other's presence on the landscape. This potentially had some degree of influence on Langford development, but Langford groups clearly resisted many socio-political and material culture signatures. In any case, it appears that regardless as to the degree of influence on Langford development, these groups remained distinct from their contemporaneous Oneota counterparts.

Ceramic Technology

Langford ceramics very similar to Oneota ceramics. Langford ceramics are most like Grand River assemblages found in Wisconsin as they are to Fisher vessels in Illinois (Brown

1990; Jeske 2000). The most obvious difference is that Oneota ceramics are shell tempered and Langford ceramics are tempered with black mafic grit (Bird 1997; Brown and O'Brien 1990; Emerson 1999; Emerson et al. 2005; Jeske 1989, 1990, 2003). While grit tempered, the intentionality demonstrated by consistently choosing a fine mafic tempering distinguishes this ceramic production technology from grit-tempered Late Woodland ceramics (Brown and O'Brien 1990; Griffin 1946; Langford 1927; Jeske 1990; Schneider 2015). Vessels are generally globular shaped with design motifs like Grand River ceramics (Figure 3.6) (Brown and O'Brien 1990): "Surface treatment varies from cordmarked to smooth or smoothed-over cordmarked, and design elements include curvilinear and rectilinear trailings and chevrons. Chevrons are sometimes nested, and trailings range from thin to very bold (Jeske 2003:225)." Rims are undecorated and either rounded or flattened (Brown and O'Brien 1990).

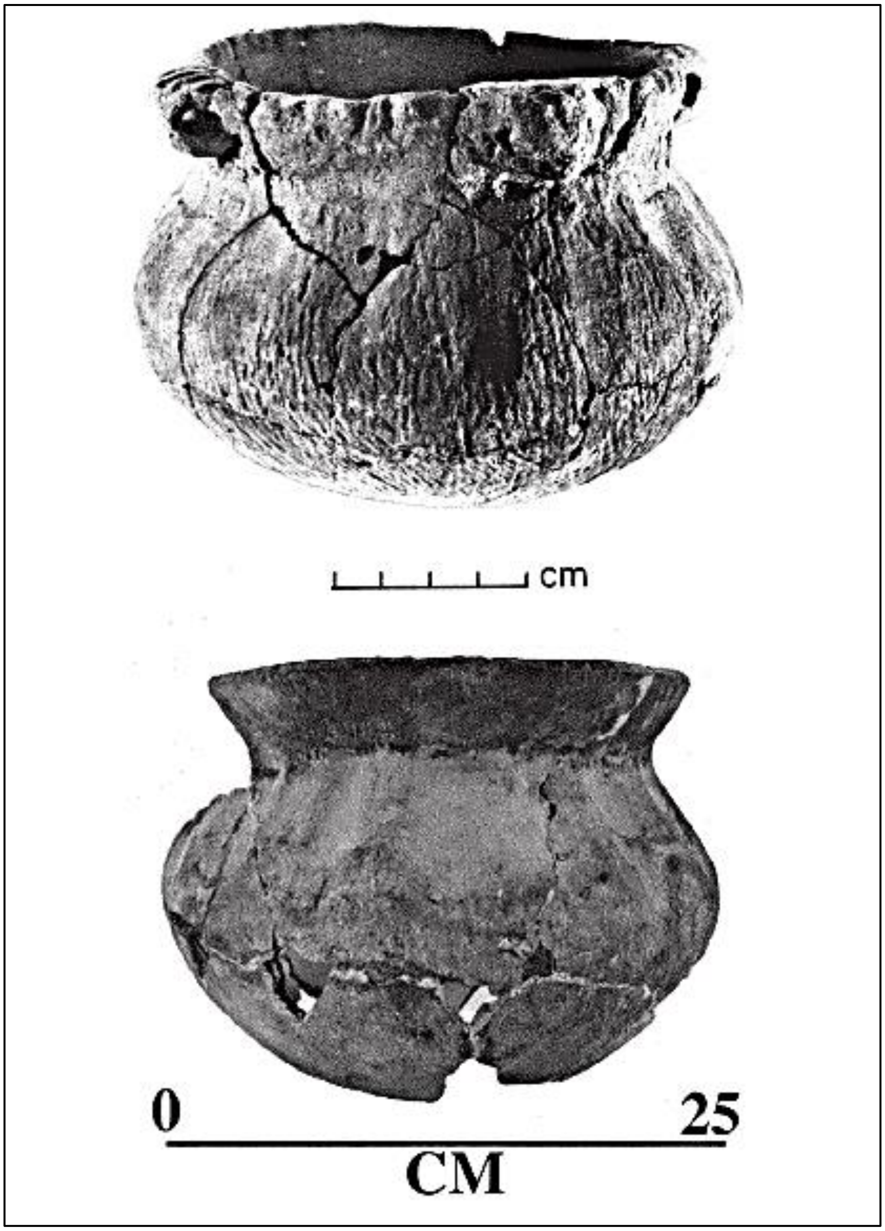


Figure 3.6. Top, Fisher (Fifield) Bold vessel from the Hoxie Site; Bottom, Langford Bold vessel from the Fifield site (Jeske 2003:177, Figure 4).

Lithic Technology

Lithic materials from Langford sites show evidence of bipolar technology, consist of relatively few formal tools, and indicate heavy dependence upon poor to fair quality local chert raw materials. Lurie (1992) reports evidence of bipolar technology and extensive tool retouching for the Robinson Reserve site. Similarly, Park (2004, 2010) reports bipolar technology and increasing use of local, lower-quality chert at the Langford component of the Zimmerman site, located in LaSalle County. Based on data from Washington Irving, Zimmerman, and LaSalle County Home sites, Jeske (1990, 1992, 2000, 2003a, b) argues that Langford lithic economic behaviors indicate a choice to economize overall energy expenditure on lithic production. He asserts that economizing behavior was a method of reducing time and energy expended for lithic tool production that could then be applied to other endeavors and is a cultural adaptation to stress (Jeske 1987, 2002, 2003b).

This reduction of energy input appears to have been achieved through several behavioral strategies: reducing the pursuit of higher quality raw materials farther from the immediate site area; investing in recycling and retooling; and using bipolar reduction techniques to maximize the potential of the low-quality chert cobbles (Jeske 1992; Lurie 1992; Wilson 2016).

Settlement Patterns/Structure Types

Generally, Langford sites can be broken down into three main categories (Jeske 2003; Hart and Jeske 1988). These include large village sites (2-5 hectares) that are usually found along larger river valleys, smaller habitation sites (1-1.5 hectares), usually found in smaller river valleys or adjacent upland areas; and small campsites (100-300m^2), typically found in upland inter-fluvial areas (Jeske 2003:165). Langford sites are generally located away from the main rivers and possible main trade and transportation routes. Even when they are found on higher upland grounds, sites are surrounded by wetland, which would have been difficult for outside raiding groups to traverse quietly (Brown and O’Brien 1990; Jeske 1989).

Copper Technology

There is not a standard pattern of Langford copper technology, nor has there been a systematic analysis of its nature. It likely follows a similar pattern to Oneota and Fisher copper use but was possibly utilized to a lesser extent. However, that is difficult to quantify since there are fewer large Langford excavations that have been conducted, and the archaeological culture lies within a smaller territorial boundary (see Emerson 1999; Foley Winkler 2011; Jeske 1989; Jeske and Hart 1989).

Mortuary Patterns

Langford mortuary patterns are varied, including single communal mounds, multiple small mounds, flat cemeteries, and isolated human remains (Brown 1967, 1990; Emerson 1999; Emerson et al. 2010; Foley Winkler 2012; Jeske 2003). Jeske (2003) argues that there are three types of Langford mound, or mounded-over cemeteries: 1) single mounds containing numerous bodies (e.g., Gentleman Farm); 2) sites with mounds containing zones (e.g., Fisher); and 3) sites where there are small mounds that only contain few bodies but are associated with habitation sites (e.g., Wild Rose Mounds, Robinson Reserve). However, as in the case of Zimmerman Grid D and Plum Island, there are burials found within habitation areas of sites with no mounds (Foley 2011). Not all Langford sites contain mound and/or recovered burials (e.g., LaSalle County Home, Washington Irving) (Jeske 2000). The McKeon village site does have conical mounds and burials; however, the Langford and Late Woodland occupations at the site make it difficult to determine which group these mounds were associated with, since there was no excavation of the mounds (Bird 1997).

Brown and Emerson have argued that mounds served two purposes: 1) as monuments over cemeteries and only secondarily as burials (Brown and O’Brien 1990; 1996; Emerson 1999); and 2) that mounds provided more space for burials within a particular location (Brown 1967, 1999). Both functions could have been used for Langford burial mounds, as these agendas are not mutually exclusive.

Subsistence Practices

Subsistence data from floral and faunal analyses indicate that Langford groups engaged in a mixed economy, utilizing wild game and practicing maize (*Zea mays*) and squash (*Cucurbita* sp.) horticulture or agriculture (Egan 1985, 1988; Emerson 1999; Emerson et al. 2010; Jeske 1989, 2003a, b; Parker 1966). Maize is generally ubiquitous at sites, but usually in lower densities (e.g., Egan 1985, 1988; Emerson 1999; Jeske 1989, 2003; Parker 1966; Walz 1998). However, isotopic data has demonstrated a relatively strong reliance on maize agriculture (Emerson et al. 2005, 2010; Edwards 2017; Edwards et al. 2017) Stable carbon isotopes on human and canine remains show a stronger reliance on plant resources than animal protein in the regular diet. As such, the ubiquity of maize at Langford sites, while in low densities, may be due to the emphasis within the diet and the low densities could be attributed to recovery techniques. There is a lack of use of the Eastern Agricultural Complex plants (EAC) commonly found at Oneota sites (Arzigian 2000; Egan-Bruhy and Nelson 2015). This differentiation could be attributed to a faster and stronger reliance on maize horticulture and agriculture (Emerson et al. 2005; Emerson et al. 2010; Jeske 1989, 2002, 2003), a cultural difference regarding culinary preference, or the need for a semi-reliable food source restricted to an area near villages due to territorial conscription or inter-group conflict (Edwards 2017; Egan-Bruhy 2014; McTavish 2014; McTavish and Jeske n.d.). Emerson (1999) interprets this ready adoption of maize because of the Mississippianization of the Prairie Peninsula during the rise of Cahokia. Jeske (1989, 2003a, b) argues that the lack of reliance on EAC plants is a cultural distinction between Langford and Oneota groups co-occupying the same region and is possibly due to a difference in historical trajectory from previous Late Woodland lifeways (Edwards 2017; Jeske 1990, 1992).

4. Localities and Study Sites

Lake Koshkonong Locality

The Lake Koshkonong Oneota Locality is a cluster of Oneota sites along the northwestern shores of Lake Koshkonong in Jefferson County, Wisconsin (Figure 4.1). Stout and Skavlem (1908) surveyed the Lake Koshkonong region in 1906 and 1907. During this survey, they identified Late Woodland Effigy mounds, historic Native American campsites, and villages in the region. Their work was followed up by Charles E. Brown, who mapped burial mounds, cemeteries, and garden beds within the region (Brown 1944). No systematic archaeological excavation had taken place up to this point.

Robert Hall conducted excavations at the Carcajou Point site (47JE02) on the shore of Lake Koshkonong. Hall's (1962) analysis established a baseline for Woodland and Oneota material culture expectations for the region. Hall further established the ceramic type classification schemes, still used as a baseline today (Hall 1962; Schneider 2015).

David Baerreis conducted field school at the Crescent Bay Hunt Club Site (CBHC) through UW Madison in 1968. CBHC is also along the shoreline of Lake Koshkonong but slightly southwest from Hall's excavations at Carcajou Point. Baerreis identified a subrectangular post-walled structure and several pit features (Gibbon 1969). Fortier's (1974) Master's thesis was the first faunal analysis at CBHC, specifically focusing on fish remains from screened and flotation contexts (Fortier 1974). Until Hunter (2002), this was the only faunal analysis creating a baseline for diversified subsistence strategies. Hunter's (2002) analysis supported Fortier's (1974) diversification results.

Janet Spector (1974, 1975) conducted test excavations at the Crabapple Point site (47JE75) and identified it as a multi-component site, spanning Late Woodland, Oneota, and Late

Woodland occupations. There have been Historic Winnebago (also known as Ho-Chunk) remains and associated artifacts recovered. However, these remains were not co-mingled, so there was no evidence of a proto-historic context or late Oneota groups interacting with historic populations in the Lake Koshkonong Locality.

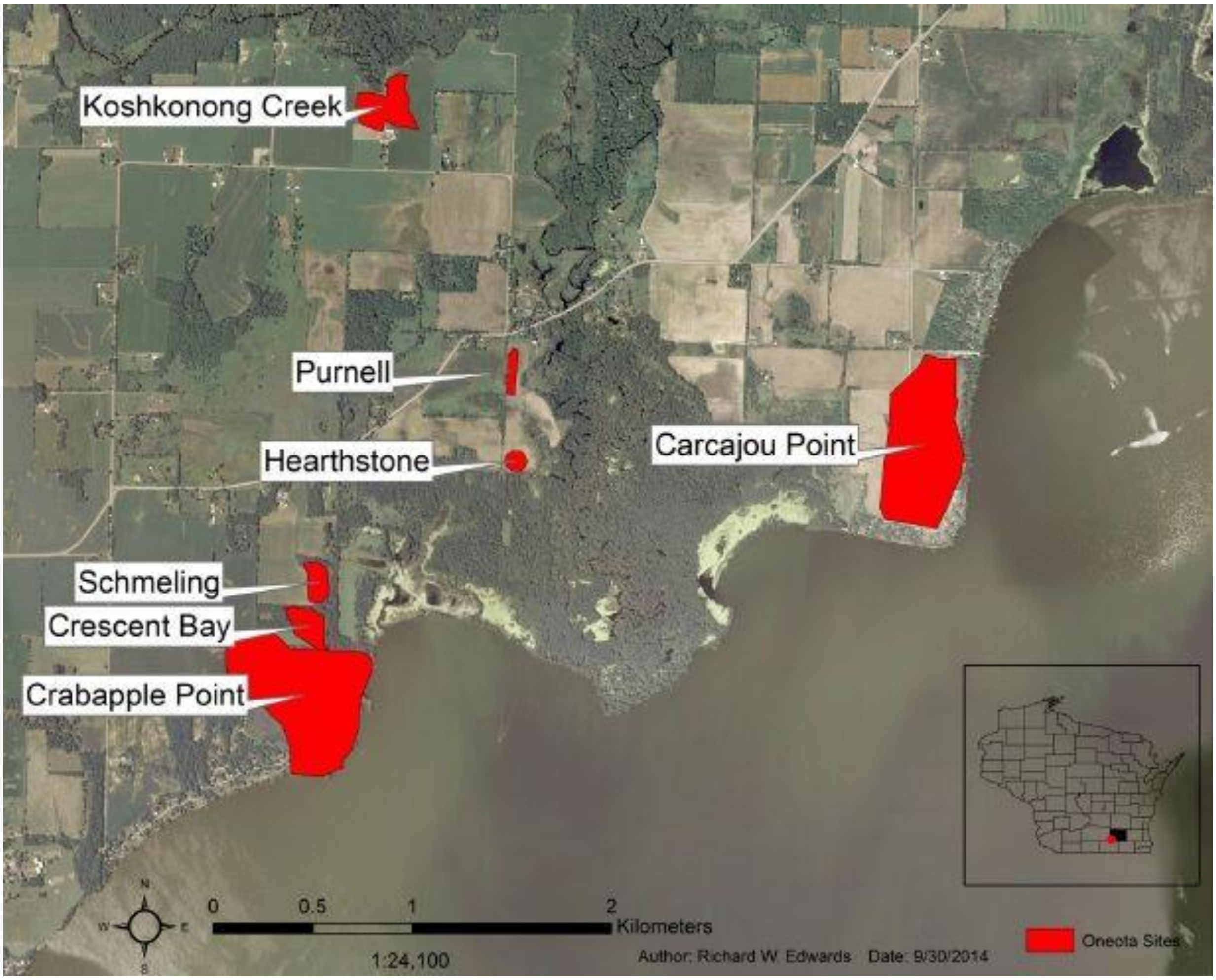


Figure 4.1. Oneota Sites within Lake Koshkonong Locality

Edwards (2010) investigated for the environmental utility in site-settlement patterns through circular catchment modeling (Figure 4.2). This research lead to an intensified investigation for how these local ecological niches manifested within the archaeological record (see Edwards 2017) and is used as a reference point for faunal expectations for this locality (McTavish 2018).

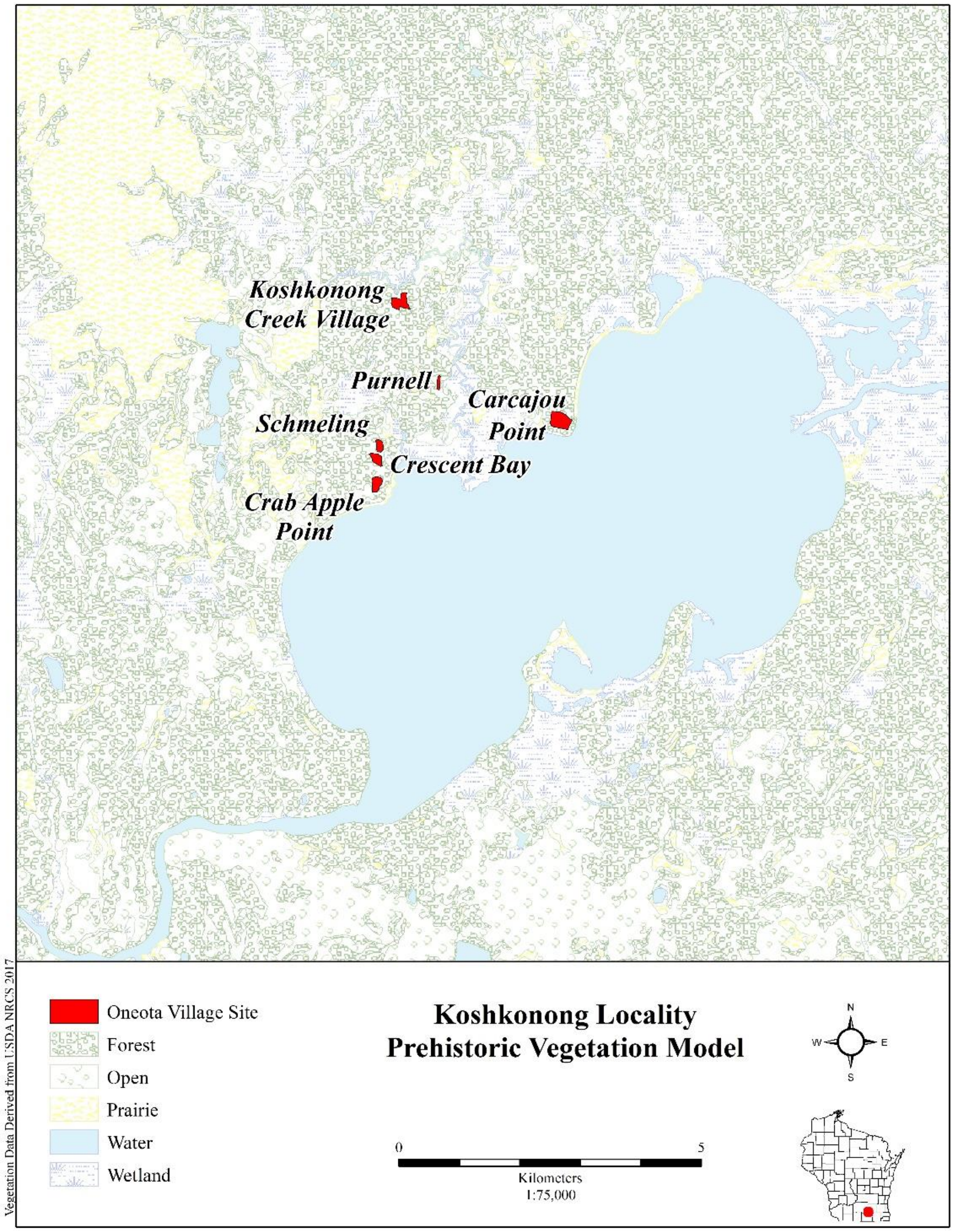


Figure 4.2 Catchment Models of Lake Koshkonong Sites by Edwards (2010)

The University of Wisconsin–Milwaukee (UWM) has conducted both excavation and survey work in the region since the late 1980s. Under the auspices of the Crawfish River Archaeology Projects, directed by Lynn Goldstein, Musil (1987) surveyed and identified new sites in the region. Further confirmation of intact deposits at the previously reported sites were also fundamental to the UWM research at the time.

In 1995, Paul Hanson conducted a survey at CBHC. This work was followed by Robert Jeske's founding of a biennial field school at the site from 1998 through 2017. Jeske's field schools also conducted research during this time at the Schmeling, Koshkonong Creek Village, Crabapple Point, Carcajou point, Hearthstone, Parnell, and Blue Herron sites within the Lake Koshkonong Locality (Edwards 2010, 2017; Foley 2012; Jeske et al. 2003; Schneider 2016; Sterner 2012). Excavations targeting Oneota components at CBHC, KCV, Schmeling, and Blue Herron have produced a large collective assemblage of lithics, ceramics, floral and faunal remains.

Residue from recovered ceramic sherds have provided a basis for radiocarbon dating in the locality. By using ceramic residue, a ceramic chronology as well as combined pooled means for the sites has been created—and has been added to throughout the years. The calibrated radiocarbon dates (Figure 4.3) indicate that the Oneota occupation of this locality spans from approximately AD 1050-1430 (Birmingham 2006; Jeske 2001, 2008; Jeske and Sterner Miller 2015; Richards and Jeske 2002; Richards et al. 1997; Schneider 2015).

Crescent Bay Hunt Club

The Crescent Bay Hunt Club site (47JE904) or CBHC is an Oneota village site situated atop a nine-meter limestone ridge that overlooks wetlands and Lake Koshkonong to the east (Edwards 2010). It was placed directly between wetlands and aquatic environments on the high points of the landscape along the western shore of Lake Koshkonong (Edwards 2010). In addition to the subrectangular house located by Baerreis, the UWM field school has identified two additional subrectangular houses, three probable longhouses with evidence of multiple

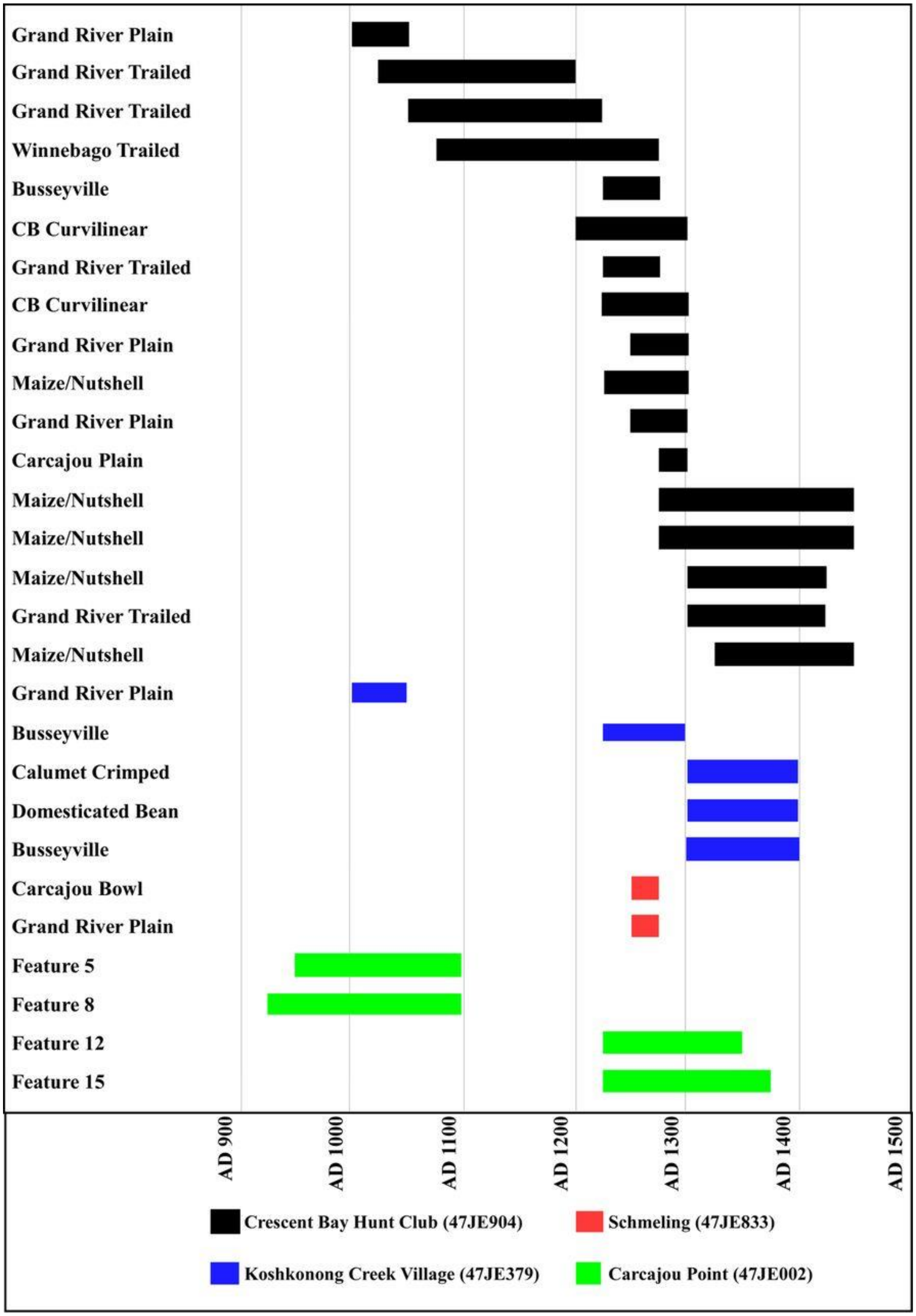


Figure 4.3. Lake Koshkonong Locality Radio Carbon Assays, from Sterner Miller 2017:78

construction episodes, a semi-subterranean structure, and approximately 100 pit features. More than 99% of ceramics recovered are Oneota styles, including Grand River and Carcajou wares. However, the signature ceramic type for the locality is Busseyville. Busseyville was first identified by Hall (1962) and redefined by Schneider (2015). The lithic assemblage is typical of an Oneota occupation (Jeske and Sterner Miller 2015; Moss 2010; Sterner 2012a, b; Sterner Millner 2014). Based on the palimpsest of overlapping features and rebuilt houses, it is likely that the site was occupied or reoccupied over an extended period. This assertion is supported by radiocarbon dates that range between AD 1000-1400 at the two-sigma level and have a pooled mean of 1250-1300 (Jeske 2010).

Schmeling

The Schmeling site (47JE833) is located on the same ridge overlooking Lake Koshkonong as the Crescent Bay Hunt Club site. The two sites are separated by a natural draw, running from the northwest to the southeast. First reported by Stout and Skavlem 1908, the Schmeling site overlaps a cultivated field and wooded area owned by the Schmeling family. The site is located with prairies to the west and aquatic resources (wetland and lake) to the south and east (Edwards 2010).

Beginning in 2004, UWM conducted a series of surveys on the farm fields west and on the ridge overlooking the lake. The surveys indicated two major scatters and two artifact concentrations. Schmeling is a multi-component site, with the earliest occupants from the Paleo-Indian tradition and the latest from the Historic Period. However, there is horizontal stratification. Paleoindian materials are found exclusively on the western edge of the site. Historic materials were found exclusively at the extreme eastern portion of the site, but that area was destroyed by mining operations in the 1960s (Kevin Schmeling, personal communication, 2004). In 2006, excavations consisting of two 4x4 meter units, were placed near the densest concentration of positive shovel probes in the wooded area of the site. During the 2008 field season, four units were added (Edwards 2010; Foley Winkler 2008, 2012; Schneider 2016). A combined total of six features and three burials were excavated. There is a small cemetery component, with three bundle burials clustered at the edge of the bluff overlooking Lake Koshkonong (Foley Winkler 2011).

Koshkonong Creek Village

The Koshkonong Creek Village site (47JE379) or KCV is a multi-component site that includes a large Oneota village. The settlement overlooks Koshkonong Creek, and is approximately six kilometers upstream from Lake Koshkonong, or three kilometers overland (Edwards 2010, 2017). The site is placed on high ground, approximately nine meters above the current level of the creek. Also, originally noted by Stout and Skavlem as Koshkonong Creek Mounds and village. Based on a series of regional surveys (e.g., Musil 1987; Rodell 1984), KCV is situated in an atypical location for the locality. The UWM field school, under the direction of Dr. Robert Jeske, conducted excavation and survey between 2010-2017, primarily focused on the Oneota component of the site (Cowell et al. 2008; Pater et al. 2010; Edwards and Spott 2012; Edwards 2014). In 2012 and 2014 and 2017, under the direction of Jeske and with field supervision by Richard Edwards, 85 square-meter excavation blocks were opened in the intersection of the densest concentrations from previous surveys. A total of 36 pit features were excavated. The post molds and wall trench represent at least two different house structures. Two radiocarbon assays were obtained from cylindrical pits. The two-sigma curve suggests an occupation between AD 1000 and 1400, which matches well with the Oneota occupation at the Crescent Bay Hunt Club.

In 2016, Edwards returned to the site with a small group of volunteers to expand test excavations for the Oneota village component. These excavations helped Jeske's 2017 UWM field school excavations to expand the spatial and material investigation at the site. The results of these excavations are still being processed (see Edwards 2017; Jeske et al. 2017).

Summary

The Lake Koshkonong locality comprises a series of contemporaneous occupations along the shoreline, all clustered within a few kilometers of each other. The sites within the locality may have been occupied at exactly same time, groups moving around year to year or every couple of years. Ceramic lithic and subsistence data suggest that they are isolated from other localities, although some cultural contacts based on ceramic form and motifs.

Fox/Des Plaines Langford Locality

Archaeological investigation of Langford sites within the Des Plain and Fox River Valleys was primarily due to accidental discovery and initial avocational and survey work (Figure 4.4) (Bareis 1965; Bird 1997; Birmingham 1975; Brown 1961, 1965, 1990; Brown et al. 1967; Craig and Galloy 1996; Early 1973; Emerson 1998, 1999; Emerson and Brown 1992; Emerson et al. 2010; Foley 2012; Fowler 1952; Jeske 1989, 1999, 2002; Jeske and Hart 1988; Langford 1927, 1928). The archaeological categorical distinctions between Langford and Oneota groups was first initiated by George Langford at the Fisher site in 1927 (Langford 1927, 1928). This distinction of two potential cultural identifies was discussed primarily in relation to ceramic types (Brown 1961; Brown et al. 1967; Fowler 1952; Langford 1927, 1928). Melvin Fowler's analysis of the University Chicago excavations at Robinson Reserve allowed for initial breakdowns of Langford archaeological culture characteristics (Fowler 1949, 1952). However, the remains of these excavations have been lost and are therefore unavailable for future researchers to reexamine them (R. Jeske, personal communication, 2016). Afterwards, systematic excavations and survey work were undertaken under the auspices of Northwestern University and Midwest Archaeological Research Services, with respective excavations and surveys directed by Robert Jeske and Rochelle Lurie (Lurie 1992). Specifically targeting sites for initial survey and excavation (e.g., Robinson Reserve) as well as returning to previously reported sites allowed for the creation of a baseline of Langford assemblage data which researchers have used as a basis for comparison, modifying it over time (e.g., Gentleman Farm; Zimmerman Grid-D) (Brown and O'Brien 1990; Emerson et al. 2010a, b; Emerson et al. 2005; Emerson and Emerson 2015; Foley Winkler 2011; Hunter 2002; Jeske 1989, 1990, 1992, 2003; McTavish 2015; Wilson 2016).

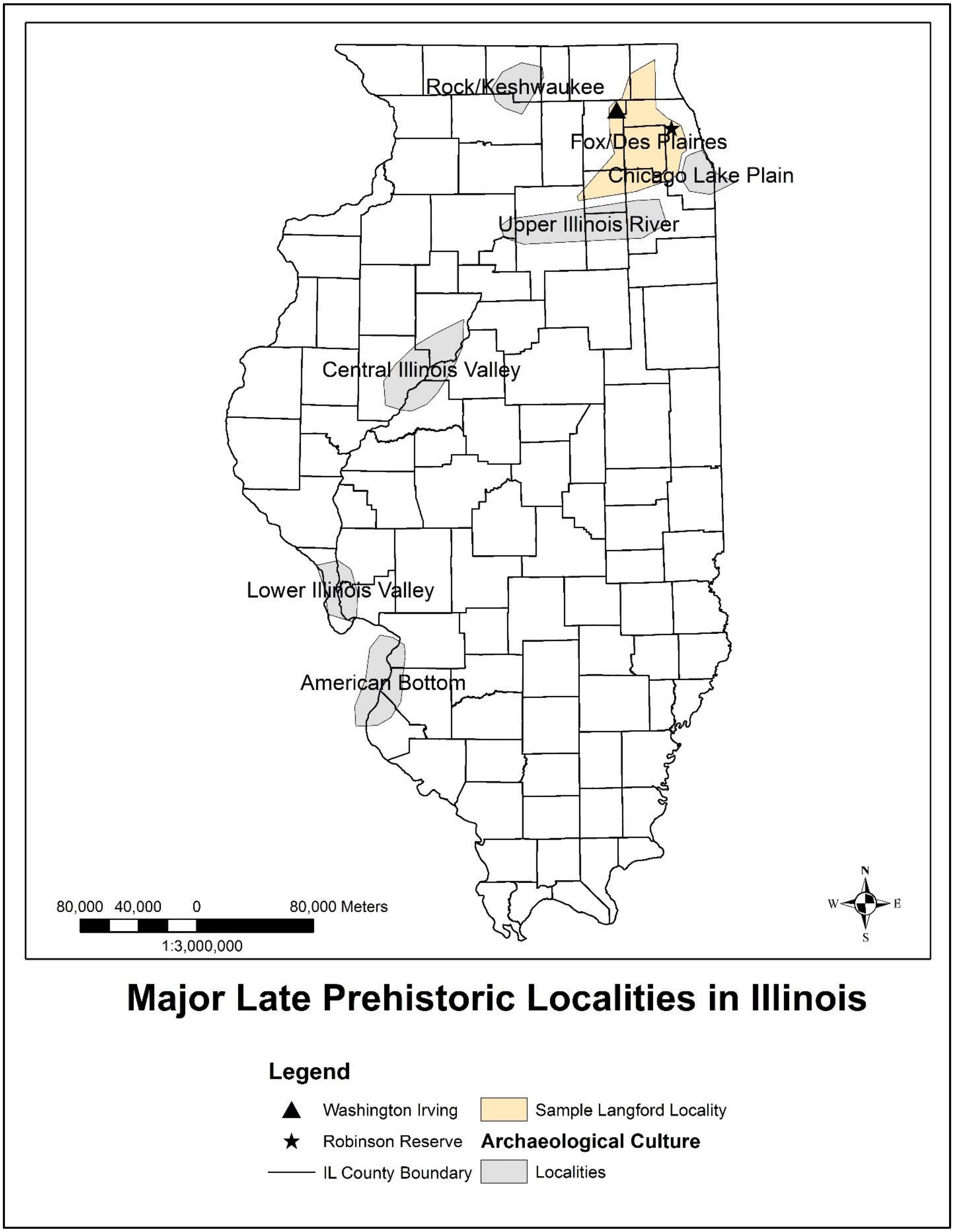


Figure 4.4. Late Prehistoric Localities in Illinois

While there are often localities, or clusters of sites packed together, around a single watershed within an area, the Langford localities are clustered in a looser manner than Wisconsin Oneota sites. There are four Langford sites within the study locality (Fox/Des Plaines) with the most excavation: Robinson Reserve, Cook, Plum Island and Washington Irving. Robinson Reserve and Washington Irving are the most substantial sites with distinct Langford contexts (Figure 4.5). While there are two different watersheds within this locality (e.g., Fox and Des Plaines Rivers), these watersheds are approximately 40km apart where the sites are located. The distance between Washington Irving to Cook is approximately 7.8km, Washington Irving to Robinson Reserve is approximately 40km, Robinson Reserve to Cook is approximately 33km (Figure 4.6).

Although this is a relatively further distance than what one typically associates with Upper Mississippian localities, many Langford sites are scattered on the landscape, with the largest clustering at the confluence of the Du Page, Fox, and Kankakee Rivers feeding into the Lower Illinois River Valley (Brown 1964; Brown and O’Brien 1991; Early 1973; Jeske 1990; Jeske and Hart 1988). In contrast, along the northern edge of the generalized Langford territory in northern Illinois, Langford sites are extremely spread apart (e.g., Keeshin Farms along Rock River). This may be the result of a combination of factors- limited sites excavated, multi-component sites with varying depositional integrity for Langford contexts, and a high level of urban development along these Illinois watersheds.

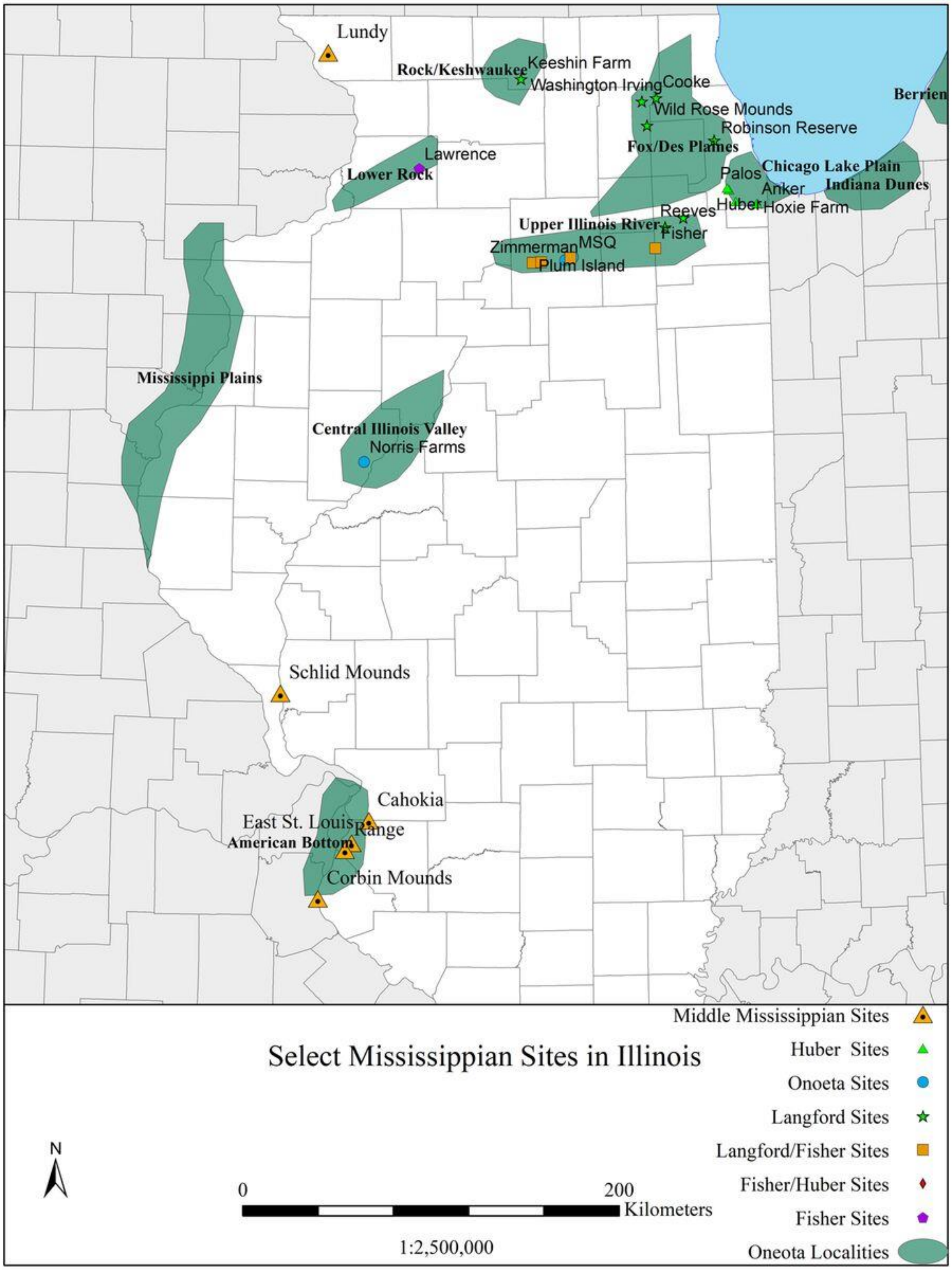


Figure 4.5. Mississippian sites and Localities in Illinois

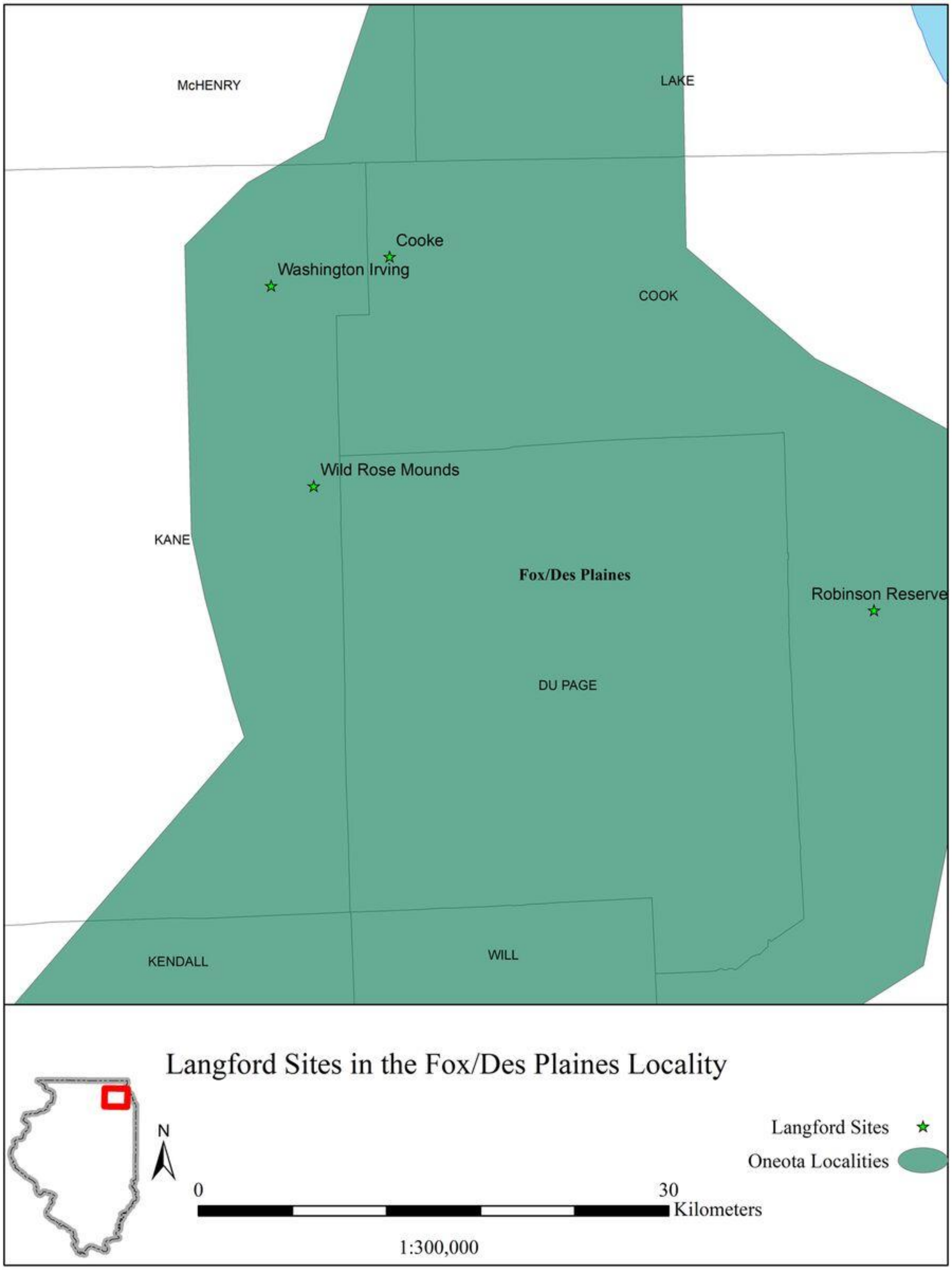


Figure 4.6. Fox/Des Plaines Locality

Ecologically, the Fox and Upper Des Plaines River Valleys are relatively similar, both containing a series of wetlands, prairie, savannas, and forested areas (Figure 4.7) (Bowles et al. 1994, 1998; DNR 1997, 1998; Meyer 1953; Moran 1978). Both the Des Plaines and Fox River valleys are geologically similar, with naturally rocky shores, making river navigability less attractive by canoe and fewer natural watercraft landings and launch points. There are various mussel and fish species available within the wetlands and creeks off the tributaries on the Fox and Des Plaines Rivers (Bowles et al. 1994, 1998; Meyer 1953; Moran 1978). The overall environments within the Fox/Des Plaines locality shift moving from river valley into more upland areas- shifting from wetland and riverine to a more forest/prairie mix (Jeske 1990). This shift in microenvironments would have allowed site inhabitants to maintain a series of encampments or villages along the river valleys while engaging in agricultural pursuits (Bird 1997; Emerson et al. 2010; Jeske 1990, 2000; Lurie 1992).

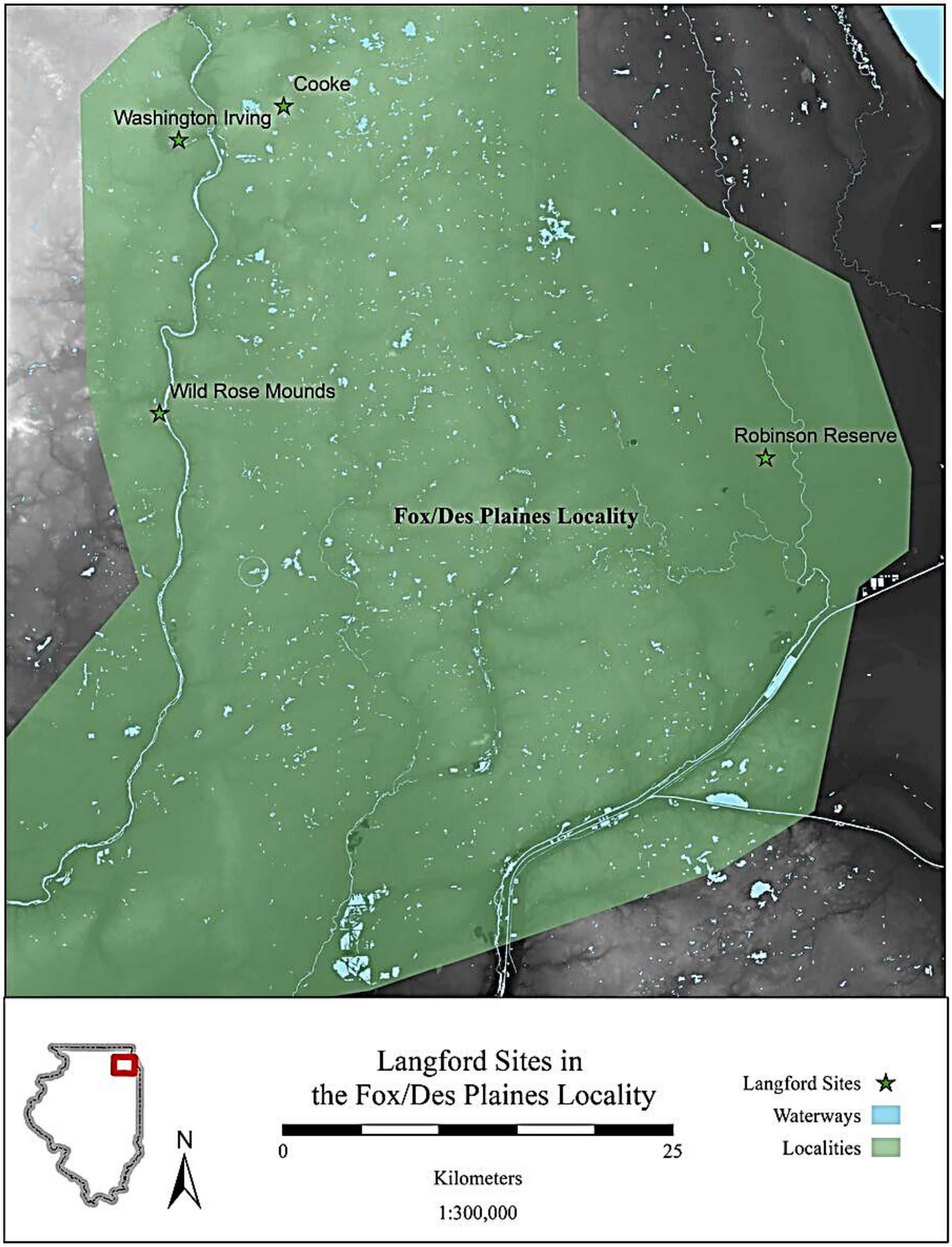


Figure 4.7. Fox/Des Plaines Locality Watersheds

> In the Des Plaines River Valley, the majority of the soils are derived from glacial drift rather than loess…. Historically, the Des Plaines basin possessed 21 miles of rapids, riffles, and rocky shallows. Today little remains of what was once considered a dangerous river (Vierling 1977). Stream width ranges from 60 feet in Lake County to 600 feet in Will County. The river bottom is of bedrock, largely covered with sand and gravel, but bare rock is found in portions of its swiftest descent. (DNR 1998:111)

> The [Fox River] basin is about 130 miles long, from north to south, and rarely exceeds 25 miles in width. Due to its linear shape, only four large tributaries contribute to the Fox River… One of the unique characteristics of the Fox is the glacially formed lakes in the northern part of the basin, particularly in Lake and McHenry counties… Glacial lakes in the basin were sculpted in two ways: interlaced morainic ridges produced cups or kettles within which lakes formed, or large chunks of ice that broke off the receding glacier were buried in the upper basin and melted to form lakes. (DNR 1997:3)

While the Langford locality combines the Fox and Des Plaines River Valleys, it is similar enough in ecology and overall more spread out nature of the northern Langford sites indicates that this analytical boundary is appropriate when making comparisons to already established site clusters for Late Prehistoric groups in Wisconsin.

Robinson Reserve

Robinson Reserve is a Langford village and burial mound site dating to approximately AD 1215-1370 (Lurie 1992). The site is located along the Des Plaines River in Cook County, Illinois, near the Chicago-O’Hare airport (Figure 4.8).

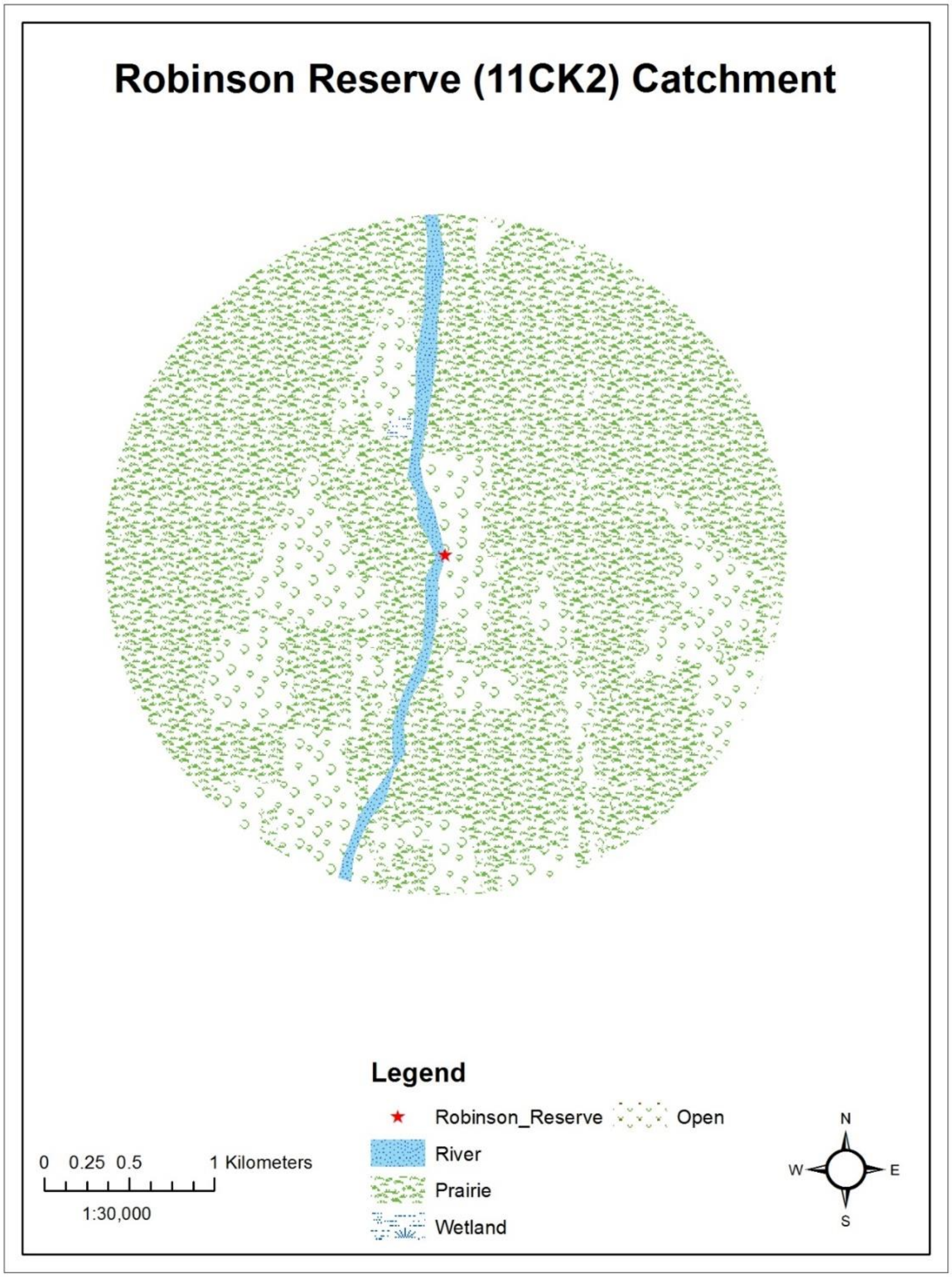


Figure 4.8 Robinson Reserve Circular Catchment Model

First excavated from 1939-1941 by the University of Chicago after accidental discovery, the site was reported by Melvin Fowler in his master's thesis in 1949 (Fowler 1949, 1952). Approximately 300 square feet were excavated (12 5x5 feet units), resulting in the recovery of 29 features and the documentation of two burial mounds (Fowler 1952:51). Fowler's work combined detailed excavation maps and burial placement within the southern burial mound with a descriptive analysis of associated ceramic, lithic, and faunal data (Fowler and Hall 1978). From 1986-1988, Northwestern University excavated approximately 161 square meters of the habitation area as well as a portion of the northern mound. Shovel probe survey of the river terrace determined the site boundaries (Lurie 1992).

Washington Irving

The Washington Irving site (11K52) is a four-hectare Langford village located along Jelkes Creek in the Fox River Valley in Kane County, Illinois (Bird and Lurie 1993; Jeske 1990, 2000) (Figure 4.9). Seven radiocarbon dates (Table 4.1) place the occupation of the site between AD 1100-1440 (Jeske 2000), with some additional early dates placing the occupation closer to AD 1100 (Jeske and Richards; Wilson 2016).

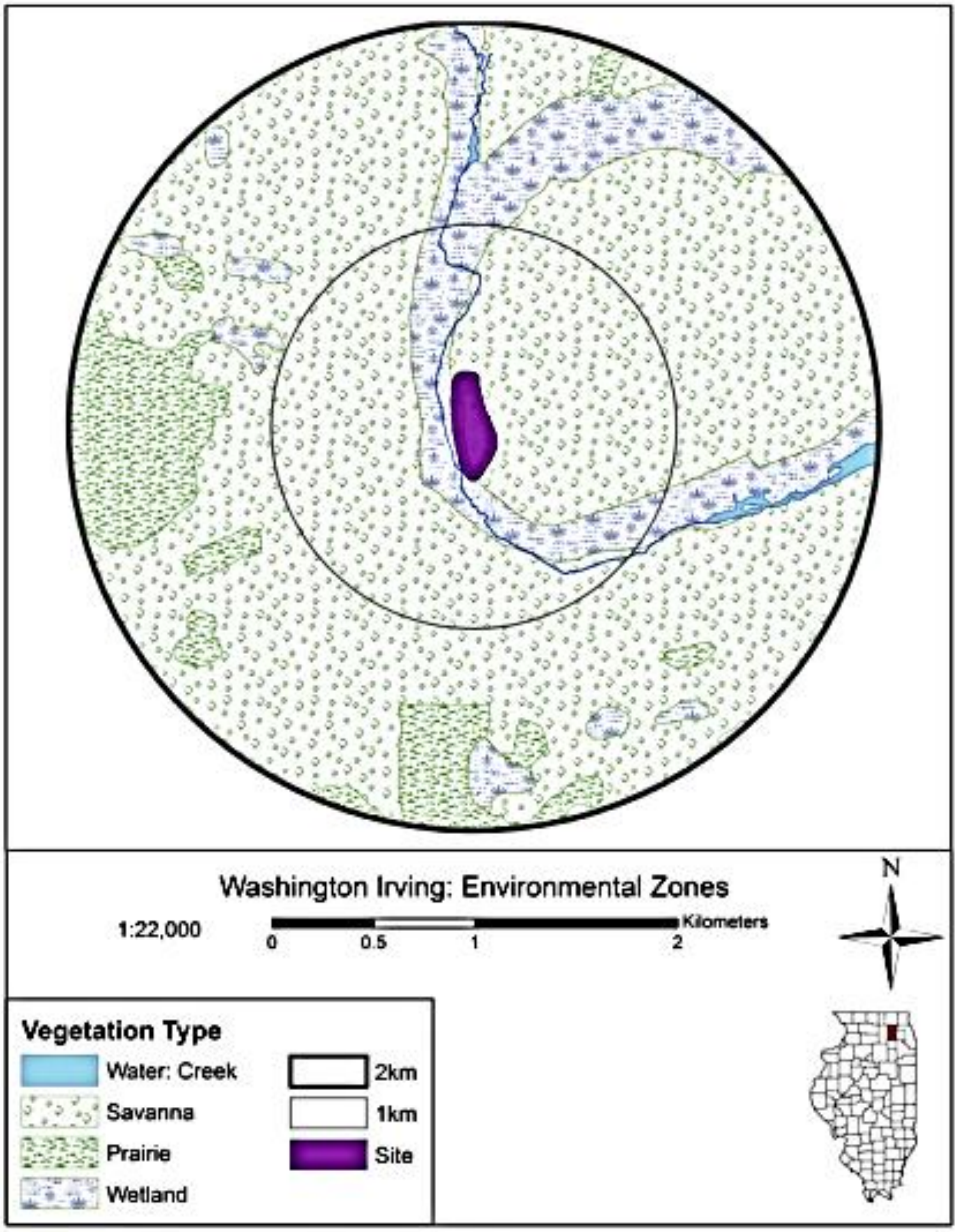
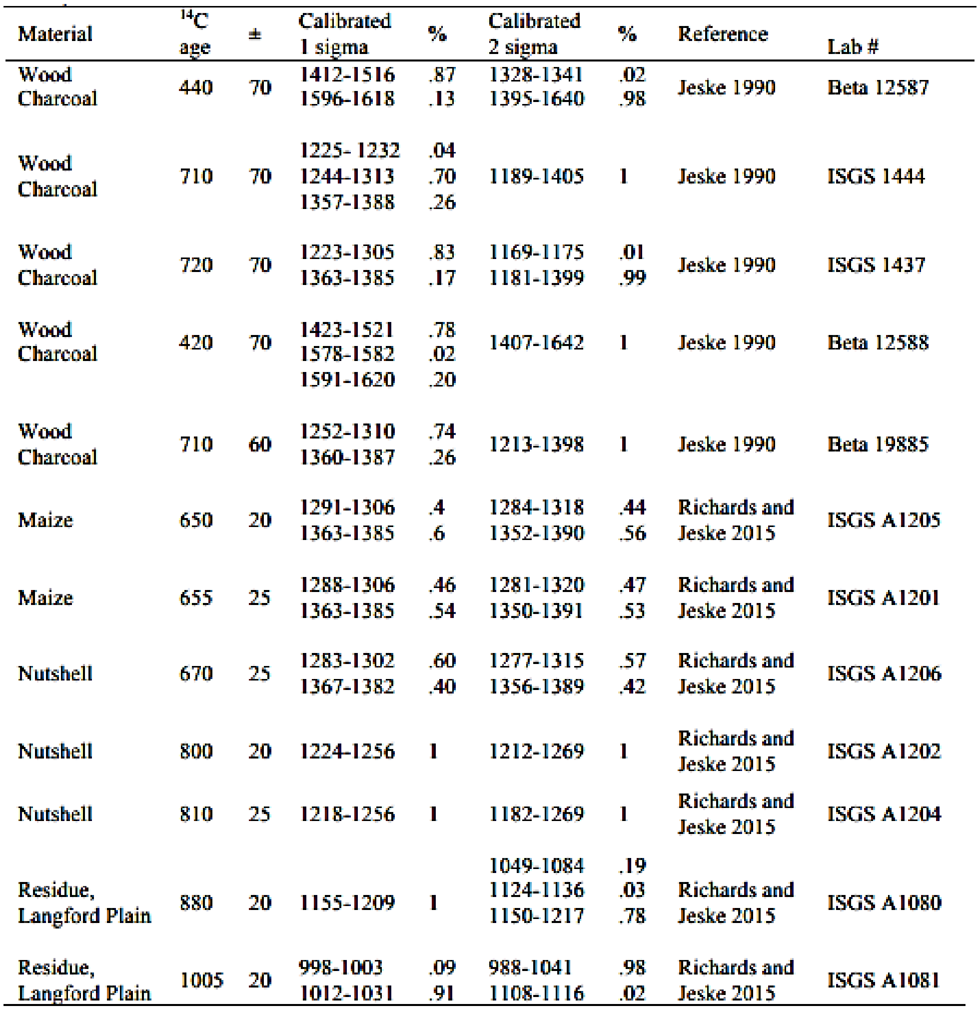


Figure 4.9 Washington Irving Catchment Model, from Wilson 2016

Table 4.1. Washington Irving Radiocarbon Dates, from Wilson 2016:47.



Material	^{14}C age	±	Calibrated 1 sigma	%	Calibrated 2 sigma	%	Reference	Lab #
Wood Charcoal	440	70	1412-1516 1596-1618	.87 .13	1328-1341 1395-1640	.02 .98	Jeske 1990	Beta 12587
Wood Charcoal	710	70	1225- 1232 1244-1313 1357-1388	.04 .70 .26	1189-1405	1	Jeske 1990	ISGS 1444
Wood Charcoal	720	70	1223-1305 1363-1385	.83 .17	1169-1175 1181-1399	.01 .99	Jeske 1990	ISGS 1437
Wood Charcoal	420	70	1423-1521 1578-1582 1591-1620	.78 .02 .20	1407-1642	1	Jeske 1990	Beta 12588
Wood Charcoal	710	60	1252-1310 1360-1387	.74 .26	1213-1398	1	Jeske 1990	Beta 19885
Maize	650	20	1291-1306 1363-1385	.4 .6	1284-1318 1352-1390	.44 .56	Richards and Jeske 2015	ISGS A1205
Maize	655	25	1288-1306 1363-1385	.46 .54	1281-1320 1350-1391	.47 .53	Richards and Jeske 2015	ISGS A1201
Nutshell	670	25	1283-1302 1367-1382	.60 .40	1277-1315 1356-1389	.57 .42	Richards and Jeske 2015	ISGS A1206
Nutshell	800	20	1224-1256	1	1212-1269	1	Richards and Jeske 2015	ISGS A1202
Nutshell	810	25	1218-1256	1	1182-1269	1	Richards and Jeske 2015	ISGS A1204
Residue, Langford Plain	880	20	1155-1209	1	1049-1084 1124-1136 1150-1217	.19 .03 .78	Richards and Jeske 2015	ISGS A1080
Residue, Langford Plain	1005	20	998-1003 1012-1031	.09 .91	988-1041 1108-1116	.98 .02	Richards and Jeske 2015	ISGS A1081

First described by an army expedition in 1817, it was mapped in 1838 by GLO surveyors. Between 1982-1985, field schools from Elgin Community College and the Fox Valley campus of the Center for American Archaeology, under the direction of Robert Jeske surveyed the site, conducted total surface pickup of the central 2.0 hectares, and excavated 248 square meters of the site. The 1984-1985 excavations, supervised by John Doershuk and April Sievert, uncovered 37 pit features and postholes as well as evidence for house floors. Based on the 1817 descriptions and the archaeological record, Jeske (1990) has suggested that the structures were of earth-lodge or sod-house style constructions.

Summary

The Fox/Des Plaines locality comprises a series of scattered sites along the Fox and Upper Des Plaines River Valleys. The locality was occupied by Langford groups from ca AD 100-1440. It is probable there was a combination of year-round villages like Washington Irving with outlying smaller seasonal camps like Cooke, and mortuary sites like Wild Rose Mounds (Bird 1997; Emerson et al. 2010; Jeske 1990, 2000). Groups potentially moved around year to year or every couple of generations. Ceramic lithic and subsistence data suggest that these sites were relatively isolated from other localities, although there is evidence for some cultural contact based on ceramic form and motifs.

5. Methods

Introduction

The following sampling strategy, laboratory methods, and analytical methods were used for the faunal analysis, forming the basis of interpretations for this dissertation. The parameters and results of an actualistic study to determine differences between antler working and natural taphonomy is included. The combination of vertebrate and invertebrate analyses are used in tandem for a holistic approach to satisfy the dissertation research goals.

Sampling Strategy

For all study sites in this analysis, faunal samples from screened and flotation contexts were used. There were differential recovery techniques in the field, resulting in potential biases and different sample sizes for the different respective assemblages. These are detailed below. There are also potential differences in site types, and these differences are accounted for in the analysis. The comparison of villages to non-village sites allowed for a better comparison within Langford and Wisconsin Oneota localities. A feature-based sampling strategy to account for different feature contexts and associations within larger village sites (i.e., CBHC and KCV) provide a spatial representation for the sites with the largest faunal assemblages.

The Lake Koshkonong Oneota sites (Schmeling, KCV, CBHC) were all excavated in the same manner. During excavations, intact feature deposits were bisected, with one half dry-screened in the field and the remaining half mapped in profile, and each cultural or natural stratum was collected separately and taken to UW-Milwaukee for flotation. CBHC, KCV, and Schmeling have been interpreted as village sites (Edwards 2010; Foley Winkler 2012; Schneider 2015; Sterner 2012a). However, Schmeling is the only site in the locality with a formal cemetery and no recovered structures. All fauna came from intact feature deposits within relatively close proximity to the burials, meaning that these refuse pits may be the product of mortuary rituals, ancestor veneration, and/or a different event than daily village life (McTavish et al. 2016; Van de Pas et al. 2015).

The Langford sites were excavated in an analogous manner to the Koshkonong sites, but Washington Irving was dry-screened using ½ inch mesh rather than ¼ inch mesh. This larger mesh size likely contributed to the smaller faunal sample size. Flotation samples were taken and so smaller mammals, bone fragments, and fish bones and scales were recovered. Washington Irving has been previously interpreted as a village site and is thus comparable to CBHC and KCV. Both Washington Irving and Robinson Reserve had smaller flotation samples taken from feature contexts compared with the Lake Koshkonong Oneota sites. This difference in recovery strategy influenced the sizes of the respective faunal assemblages. Robinson Reserve has been interpreted as either a small village or a potential mortuary encampment site (McTavish 2015; McTavish and Jeske n.d.). There are no structures that have been recovered or post mold lines excavated that clearly indicate structure walls (Lurie 1992; McTavish and Jeske n.d.). In this manner, Robinson Reserve may be comparable to the Schmeling site, as a potential non-village site.

The different archaeological sites required slightly modified sampling strategies to gain the most comparable datasets possible. For sites with smaller overall faunal assemblages (N< 5,000), the entire site faunal assemblage from Oneota or Langford contexts were analyzed. These sites were: Schmeling, Robinson Reserve, and Washington Irving. The reasons for these smaller faunal samples are due to excavation field methods and recovery strategies and possibly to differential taphonomic processes acting on these sites in situ.

Sites with larger faunal assemblages are those where the total N is unknown due to the size of the assemblages and lack of previous systematic faunal analyses conducted (i.e., CBCH and KCV). CBHC and KCV were similarly excavated under the direction of Robert Jeske, with student and volunteer excavations directly supervised by PhD student field directors and teaching assistants.

The sampling strategy for the invertebrate remains from these sites was conducted differently than the vertebrate remains feature-based analysis. This sampling strategy comes from an attempt to address a series of research objectives peripherally related to the research goals of this dissertation.

1) Shell was sampled by field season to gain a larger sample size and to collect data that would bring the Lake Koshkonong Locality up to an identified shell sample size comparable with LaCrosse Oneota sites, allowing for inter-locality comparisons as well as complementing ongoing research by Theler on Oneota shell exploitation.
2) Bone was sampled by feature to obtain a comparable sample size among sites. This strategy also allows for a spatial comparison of refuse pits near different structures and structure types, including a sample of fauna from possible ritual contexts.

Of important note, the CBHC invertebrate sample includes Feature 17-10 but not the rest of the 2017 field season. This inclusion is due to the anomalous nature of this feature, very dense shell deposit lacking most other artifacts. Most flotation samples from 2017 have not been processed and therefore were unable to be incorporated in this dissertation.

Sample Universe

The following explains and illustrates the spatial distribution of sample contexts per locality and each respective study site. For CBHC and KCV, the differentiation between vertebrate and invertebrate samples are shown in separate maps.

Lake Koshkonong Locality

In the Lake Koshkonong Locality, the Schmeling site was sampled based on all recovered shell and bone (Figure 5.1). This spatial relationship within the site between the fauna and formal cemetery burials is used as one avenue of socio-cultural contextualization for the faunal analysis that is has not previously been discussed in detail by researchers in the locality.

The CBHC and KCV sites have much larger excavation histories and a larger quantity of total recovered materials. Therefore, these sites did not include a 100% sample from all fauna recovered but features and field seasons were used as analytical units. CBHC and KCV features for vertebrate analysis were chosen based on the following criteria, the first of which was prioritized above all others (Figures 5.2 and 5.3):

1) Features had all flotation samples processed (soil floated, samples sieved and sorted, fauna pulled for examination)
2) Features were near or potentially associated with different structure types (e.g., wigwam, longhouse)
3) Features that provided a general representation of the total excavation areas within the site
4) Features that had a variety of shapes (e.g., pits, basins)
5) When possible, features that represented possibly different uses (e.g., ritual, village refuse)
6) When possible, features with radio-carbon dates to examine potential changes through time

Figure 5.1. Schmeling (47Je833) Excavation Unit and Features

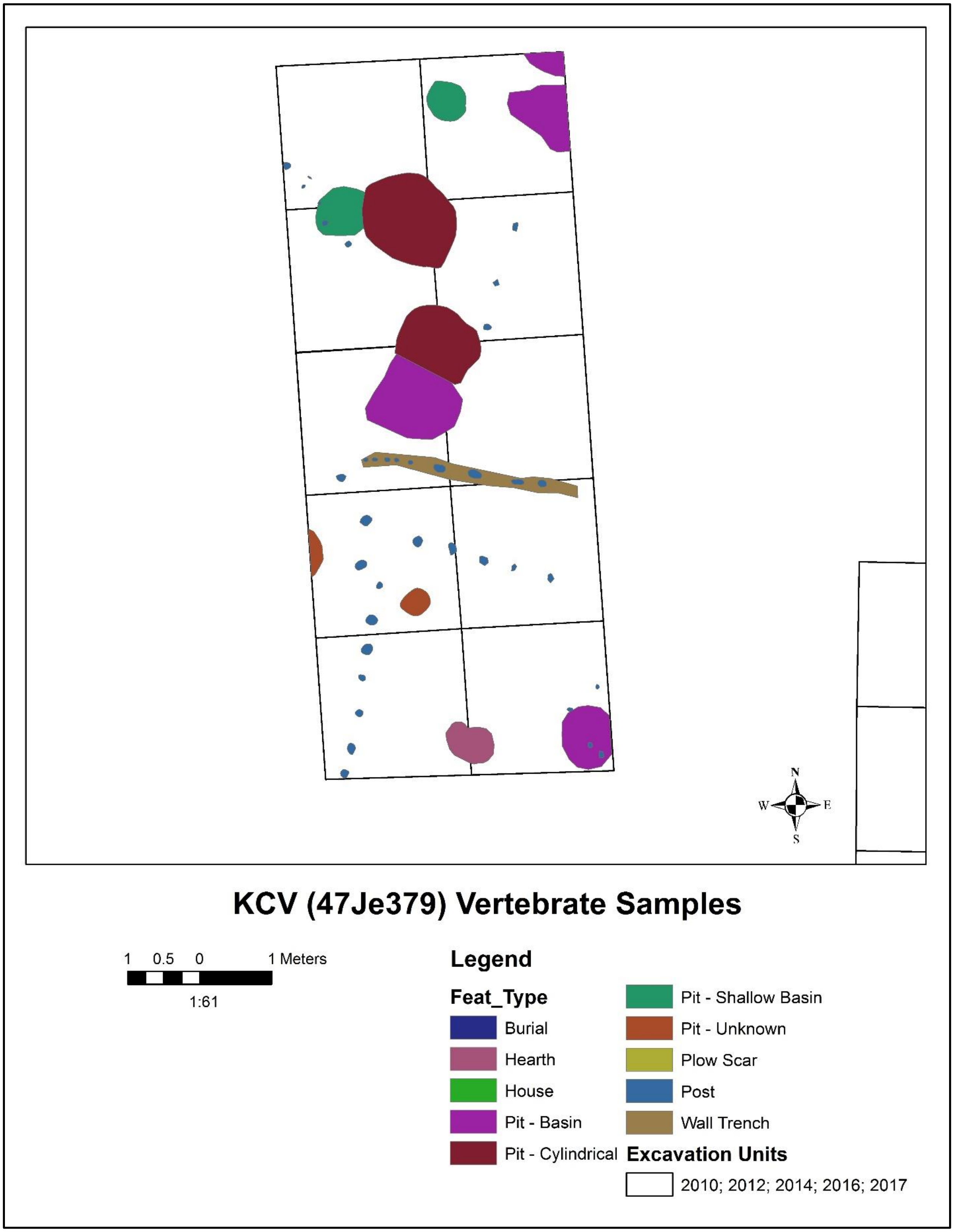


Figure 5.2. KCV (47Je379) Vertebrate Sample Context

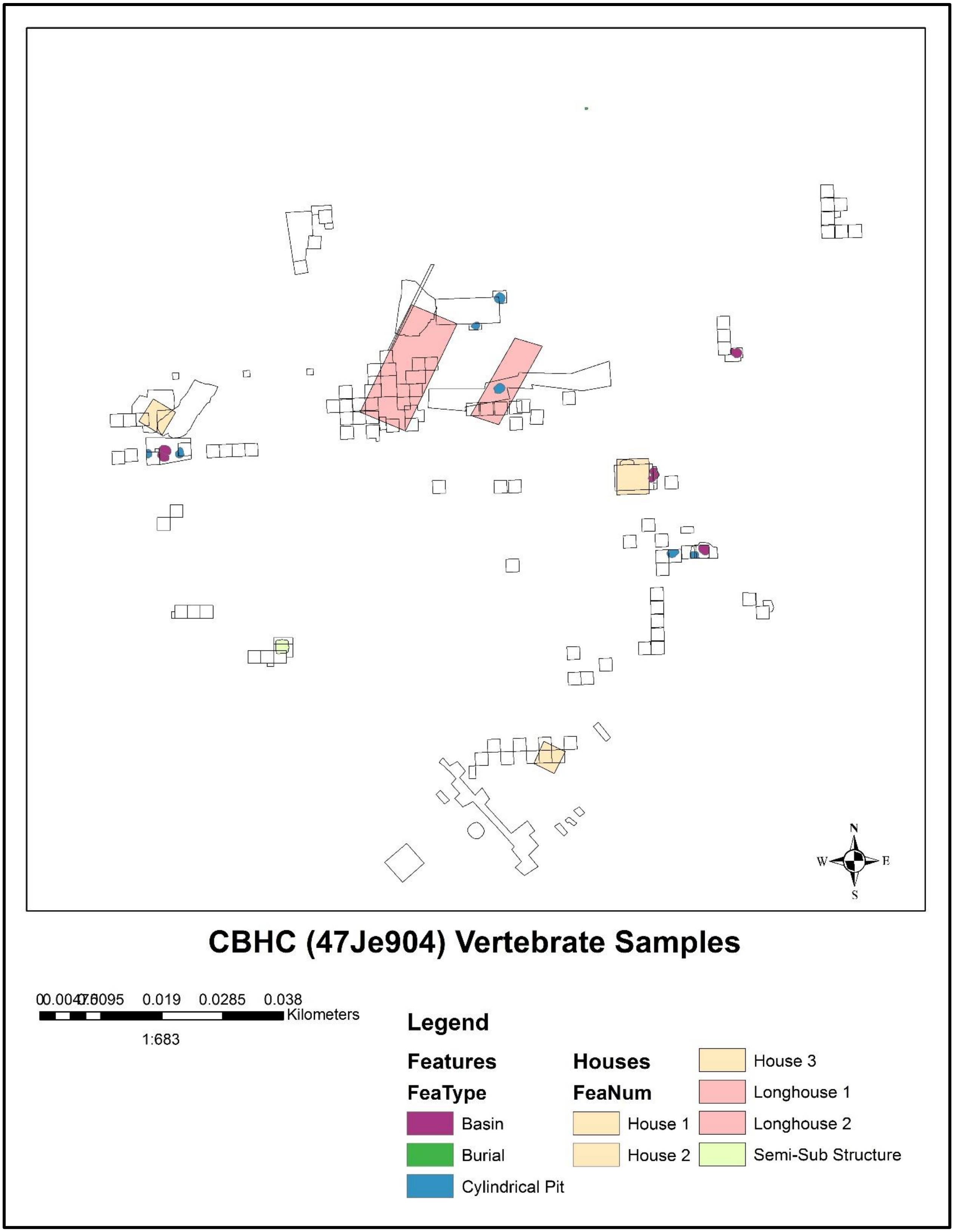


Figure 5.3.Spatial Distribution of CBHC Vertebrate Samples

Invertebrate samples were chosen based upon the selected vertebrate features. However, this sample was analyzed by field season (Figures 5.4. and 5.5) Field seasons were selected to provide a complete inventory of all invertebrate remains recovered from the sites that were associated with the selected vertebrate samples, allowing for a holistic feature representation in the faunal analysis. Further, this strategy achieves the additional objective of a larger sample size, since shell is a more fragile material and no previous research has been conducted upon invertebrate remains in this locality, except for conference papers during the data collection and writing of this dissertation (i.e., Jeske et al. 2016; McTavish 2013, 2016, 2017; McTavish et al. 2016). The one exception to this sampling strategy is the inclusion of the screened remains from Feature 17-10.

This feature was an anomaly for the locality, as it was very dense with shellfish and very few other artifacts. The materials were collected in a series of five intact clay slabs and then gently water-screened over flotation machines back at the UW-Milwaukee Archaeology laboratory. This feature was included to increase the shell sample size for the dissertation, as well as to assess this anomalous feature and its potential function within the locality. All sediments from the water screening process were floated and these samples are still being processed but will remain the subject of future research.

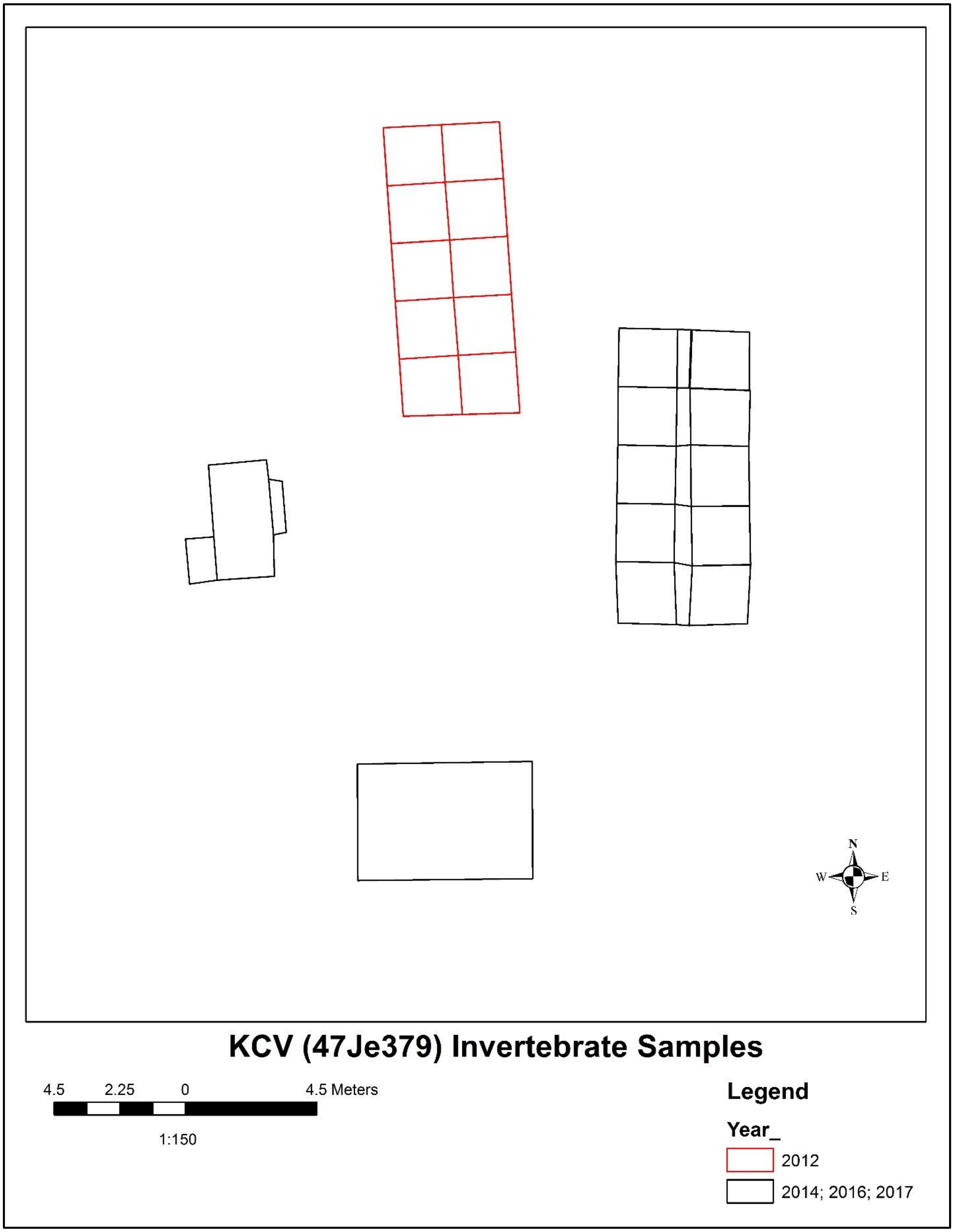


Figure 5.4. KCV (47Je379) Invertebrate Sample Contexts

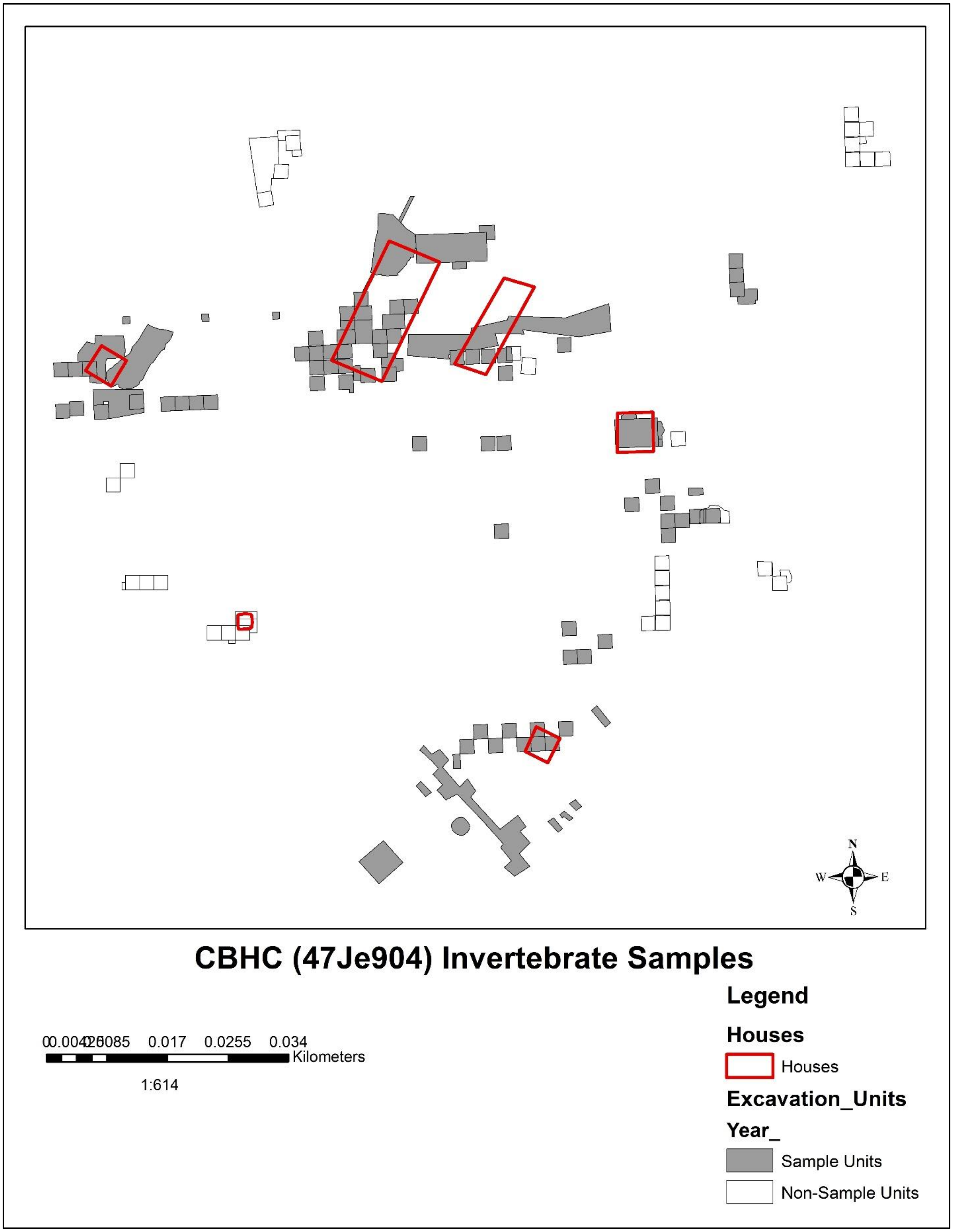


Figure 5.5. Spatial Distribution of CBHC Invertebrate Samples

Fox/Des Plaines Langford Locality

The Robinson Reserve and Washington Irving site assemblages were analyzed with 100% samples. Melvin Fowler reported faunal remains from the initial Robinson Reserve excavations in the 1920s, but those remains appear to have been discarded. Further, records do not indicate a spatial association with the fauna reported. However, these remains are used to contextualize the 1980s excavations, from which a comprehensive analysis was conducted using the same methods as all other study sites in this dissertation. These later excavations represent the occupation areas of the site rather than the mounds, thus making the assemblage more comparable to the other study sites in this dissertation (Figure 5.6).

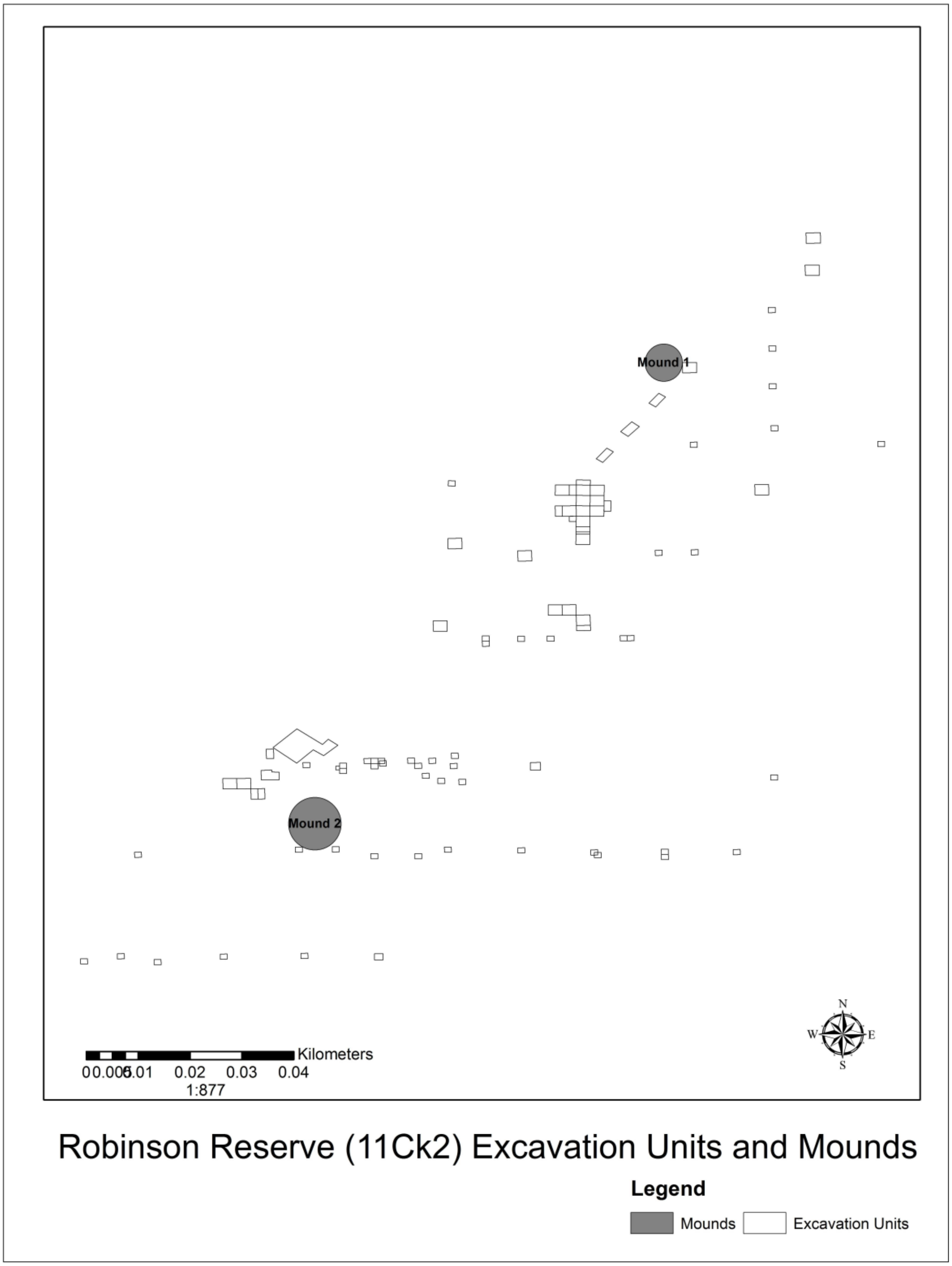


Figure 5.6. Robinson Reserve Excavation Units

The Washington Irving faunal assemblage consists of fauna recovered through systematic excavation and surface collection (Figure 5.7). This dissertation analysis differentiates remains from the surface pick-up and focuses on the excavated remains- thus retaining comparable methods between study sites and reinforcing a Langford-exclusive focus and conservative approach to context.

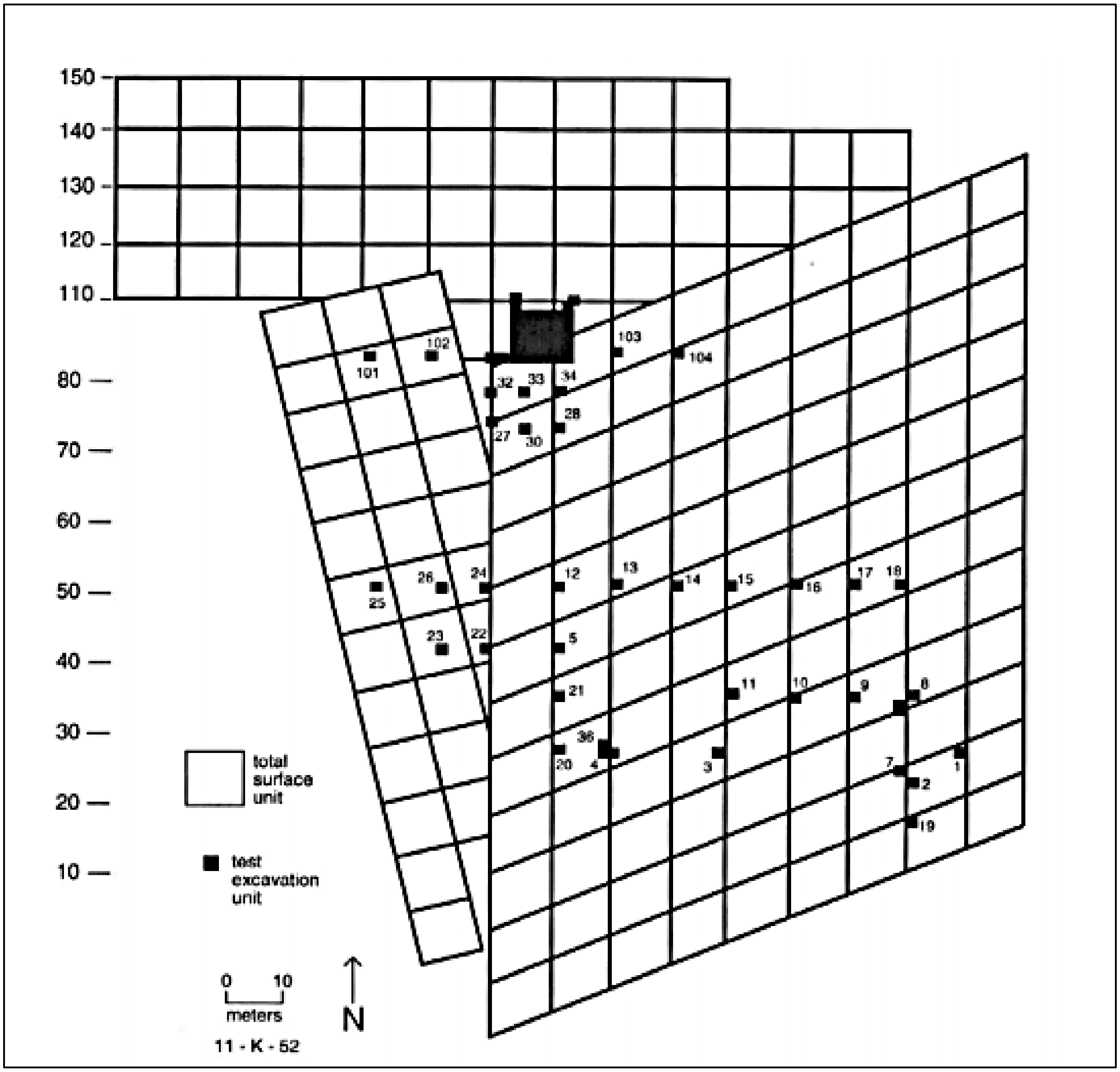


Figure 5.7. Washington Irving (11k52) Excavation Units within Surface Pick-up Grid

Laboratory Methods

As the basis for expectations for fauna in the respective assemblages, an expected faunal list was generated using open-source Illinois and Wisconsin Department of Natural Resources species lists including present, endangered, and extinct, to better narrow down the suite of osteological specimens to compare with the archaeological specimens. This list was sorted based on taxonomic class (e.g., mammal, fish, bird, bivalve). Species that are currently extinct but would have been present during the Late Prehistoric occupations were included, and species that are invasive to the study region were excluded (e.g., zebra mussels).

Faunal specimens were identified using the University of Wisconsin–Milwaukee zooarchaeological skeletal comparative collection and comparative skeletons on loan from the University of Wisconsin–Madison Zoology Museum. Both sets of comparative skeletons are currently housed in the UWM ARL. Osteological guides were used as supplementary resources for identifications (e.g. Gilbert 1990; Gilbert et al. 1996; Hillson 1968; Olsen 1968, 1979).

Each specimen was sorted based on provenience and taxonomic class and weighed using an Ohaus Scout-Pro scale to the nearest hundredth gram. Modification identifications and highly fragmented specimen identifications were aided by a x10-15 power table magnifier with a light. Counts and weights were recorded. Counts were quantified as the number of specimen present or NSP, while specimens identified to class, family, genus, or species were quantified as the number of identified specimens (NISP) (see Grayson 1984; Lyman 1994a, 2008). Specimen is defined as an individual piece of bone, shell, or tooth (Grayson 1984:16). Specimens were classified using distinctive interior and exterior skeletal morphological structures. Elements were recorded and used in determining family, genus, and species identifications. When a specimen could be identified as a vertebrate, but not to a specific class due to a lack of distinctive structural components, it was labeled as unidentified (UNID).

When possible, mammals that could not be identified to a taxonomic family or species were sorted into distinct size categories for comparative purposes (Table 5.1). Size categories were based on the following criteria whenever possible element fragment length and diameter (e.g., shaft) in comparison to osteological comparative skeletons and cortical thickness of fragments. A size category X was used for mammal specimens that could not be identified to any size category. Size classifications of undifferentiated mammal specimens were made conservatively, resulting in a slight bias towards the size X category.

Table 5.1. Mammal Size Categories

Size Category		**Example Fauna**	**Live Weight Ranges**
Small	I	Mice (*Mus musculus*), Squirrel (*Sciurus spp*.)	<99g-699g
Medium	II	Muskrat (*Ondatra zibethicus*)	700g-19kg
	III	Dog (*Canis familiaris*)	20-39kg
Large	IV	White-Tailed Deer (*Odocoileus virginianus*)	>40kg
Unknown	X	Unsized Mammal Fragment	

Modification to Fauna

Modifications to bone and shell were recorded whenever observed. The following categories were collected: thermal alteration, staining, animal gnaw marks, root etching, fragmentation, cut marks, worked specimens. To help determine natural taphonomy from intention cultural modification of recovered broken antler tines, an actualistic study was conducted to determine probability of antler location for marks and the likelihood they may be miss-categorized. This dissertation analysis errs on the side of caution, resulting in a possible a slight bias towards the natural taphonomy category as opposed to cultural modification as the default category assignment.

Thermal Alteration

Any bone or shell that showed evidence of thermal alteration was recorded as such and bagged and tagged separately. Three categories of thermal alteration were recorded whenever possible: Burned, Calcined, and Smoked. Burned bone was classified using the blacked coloration of the bone as the criteria. Calcination was designated when bone specimens were discolored grey, white, and/or blue-grey and had a chalky texture (see Stiner et al. 1995; Théry-Parisot et al. 2005; Ubelaker 2009; Whyte 2001). Due to the high degree of heat needed for calcination to occur, it was classified separately from burned bone. Bone that showed evidence of smoking was determined in a very conservative manner, so it is likely that this category of thermal alteration is under-represented. Smoked bone can exhibit a light greyish hue to a darker grey hue, but during the smoking process some bone may become charred black (see Ekroth 2006; Herrmann 1999; Tushingham and Bencze 2013; Vehik 1977). In such a case, that bone would have been categorized in the generalized burned bone rather than as smoked. To differentiate smoked from burned or soil-stained bones, a small personal comparative collection was used by the author, as well as the images in O'Connor's work (O'Connor 2000:77). A specific schema for recording burn patterns on large mammals based on element location was developed to assess potential patterns of cooking strategies.

Shell specimens that were colored with a grey hue and exhibited a more fragile pattern were classified as burned. Due to the nature of shell anatomy and fragility, burned/unburned was the only designation for thermal alteration. As with bone specimens, burned shell were bagged and tagged separately from unburned shell.

Staining

Three types of staining were recorded for all bone and shell specimens: red ochre, galena, and copper. In this case, galena refers to the silvery mineral, not the commonly found knappable chert in the study region.

Any bone or shell that exhibited a green discoloration was designated as copper stained. These types of staining were possibly cultural in nature. It is important to note that this staining may not be true for all copper-stained faunal specimens. For example, copper-stained fish scales were likely in contact with a copper tool, copper scrap, or float copper that had been discarded in the same midden context, rather than in repeated proximity to a copper bead or adornment that would have resulted in copper staining.

Bone or shell that was stained red was tagged and designated as red ochre stained. To distinguish between reddish soil stains and red ochre stains, if any red powder residue was present, that area was examined under x20 magnification to better determine if the residue resembled soil or ochre. Further, soil Munsell colors were recorded for each provenience in field paperwork and these documents were consulted to determine if the red discoloration could easily be explained by prolonged exposure to reddish soils.

Fragmentation

Bone and shell fragmentation can be studied through various quantitative and qualitative means. In this study, bone and shell fragmentation were quantified using different protocols that best suited the research goals of this analysis and that best accounted for the differential structural bases.

The bone fragmentation protocol was designed for its efficiency and replicable means. All bone was sieved through standard flotation mesh screens, regardless of whether samples were field screened or derived from heavy fraction flotation contexts. After fauna were sorted by provenience and to the most accurate and precise identification, these samples were screened through standard 6.33mm (~1/4”) mesh using standard circular screens used in bucket flotation. These quantifications of >6.33mm or <6.33mm were recorded in a digital spreadsheet, tracking provenience, faunal identification, counts, weights, and fragmentation size. Even for samples that were sieved after flotation and categorized as >6.33mm, not all specimens were >6.33mm. This differentiation was due to the realities of mass processing in a systematic manner where the goals were based on efficiency, as well as vertebrate and invertebrate remains curated sometimes alongside or underneath heavier archaeological materials (e.g., fire cracked rock, ceramics, rough rock, lithics), resulting in crushing to a size much smaller than 6.33mm. Consequently, this second screening provided a more accurate representation of bone fragmentation per context per taxa at the time of the analysis.

In this study, shell fragmentation was recorded based on more descriptive, and therefore more subjective, standards than the bone fragmentation. The size screening method used for bone fragmentation was deemed inappropriate for shell sizing, since sieving through screens might have damaged specimens. To obtain samples comparable with other studies, the following size categories were used.

For bivalves (e.g., mussels) the following categories were used:

1) Whole valve and umbo intact
2) ½ valve and/or umbo intact; if umbo was present it was indicated
3) < ½ valve and/or umbo fragments intact
4) Only umbo, separated from valve

For gastropods (e.g., snails) the following categories were used:

1) Whole body whorl and spiro intact
2) Body whorl with broken spiro
3) Only spiro separate from body whorl

For decapods (e.g., crawfish) the following categories were used:

1) Exoskeleton complete
2) ½ Exoskeleton
3) < ½ Exoskeleton fragment
4) Claw fragment

Of note, all shell dust was bagged and tagged by provenience, but was not weighed or recorded, since the presence of shell dust could be due to natural taphonomic processes, excavation recovery, processing that may have immersed specimens in water during cleaning, curation (e.g., shell being combined with heavier materials in boxes and getting crushed), or simply natural the degradation of fragile shell over time.

Worked Bone, Shell, Horn, Antler

All specimens suspected of being used as a tool and/or culturally modified were examined under a x60 magnification lens with an attached light. When such specimens retained skeletal articular ends, diagnostic curvatures, or other diagnostic skeletal elemental characteristics, they were identified to the most conservative accurate category (e.g., family, genus, species).

Worked shell valves were identified initially through galena and ochre staining on the dorsal umbo (hinge). Under magnification, these umbos showed evidence of striations. Striations can occur naturally from mussel bed movement and burrowing into sub-strait during the animal's lifetime or can be the result of cultural modification. Three or more striations that did not appear random or squiggly were recorded to conservatively identify these umbos as possible pigment applicator tools, and thus intentionally worked by human cultural activities (see Lamb 2011).

Actualistic Study for Differentiating Antler Working from Natural Taphonomy

Antler tines of male deer undergo changes from natural taphonomic processes and cultural modifications—e.g., through awl manufacture and the use of antler tines as flintknapping beamers or pressure-flakers. To differentiate between the signatures left by natural taphonomic processes and antler working, in 2015 McTavish designed and undertook an actualistic study of natural and flint-knapping marks on white-tailed deer antler tines. The results provide a basis for better creating a conservative estimate for natural versus cultural taphonomy for the subsequent analysis on worked antler, horn, and bone at all study sites. A summary is presented below. This specific differentiation is relevant to this dissertation, since one major research focus in the Lake Koshkonong Locality and Fox/Des Plaines localities has been lithic technological organization and chipped stone tool uselife (e.g., Jeske 1990, 1992; Jeske and Sterner Miller 2015; Lurie 1992; Sterner 2012a, b, 2015; Sterner and Jeske 2016; Wilson 2017).

The white-tailed deer antlers examined showed differences in striations and percussion fractures from their uselife as a part of the animal as well as their use as trophies by hunters prior to their modification in chipped stone manufacture. Antlers used included four previously unused antlers from white-tailed deer: one shed, two attached to the frontal bones, and one modified by a flintknapper prior to use. Following the procedures outlined in Whittaker (1994:128, 130, 182), the specimens were collected, taphonomic signatures recorded, and the tines manufactured into soft-hammer batons, with one intact tine used in pressure flaking.

At a macroscopic level, striations were found throughout the antlers in a seemingly random pattern and at random orientations. Magnification (x20) using a hand lens with an LED light was conducted to differentiate striations from small linear surface stains. A systematic quantification of striations was recorded using anatomical locations on the antlers (e.g., base, main beam, tine), allowing for the testing of potential patterning within a single antler based on anatomic location. The same techniques were used for examining small flake scars and impact fractures.

Two flintknappers were included in this study, a novice (Rachel McTavish) and an experienced flintknapper (Barbara McClendon). This inclusion of two knappers allowed for inter-knapper variation in skills as well as differences in the duration of antler use as a tool to be considered. Raw materials commonly reported in lithic analyses in the Midcontinent were used: Galena, Wyandot, Burlington, heat-treated Burlington, and obsidian. Obsidian, while not local to the upper Midcontinent, is recovered as a trade item and locally manufactured from curated cores.

Principal component analysis was used to explore variation and emphasize strong patterns in the dataset. Patterns of striations, impact fractures, and flake scars were compared based on location on the antler prior to their use as tools and after use in soft-hammer percussion and pressure flaking. The principal component analysis was run on the antlers as a combined population (N=4), comparing anatomical location relating to use and type of signature on the antler.

Different patterns relating to taphonomic, soft-hammer, and pressure flaking damage to the antler base do appear to be evident (Figure 5.8). Soft-hammer percussion appears to leave distinctive proportions of marks on the base of the antler as opposed to taphonomic processes and pressure flaking. This result is not surprising, since it the base of the antler that strikes the biface or core. As expected, pressure flaking really does not impact the base of the antler at all.

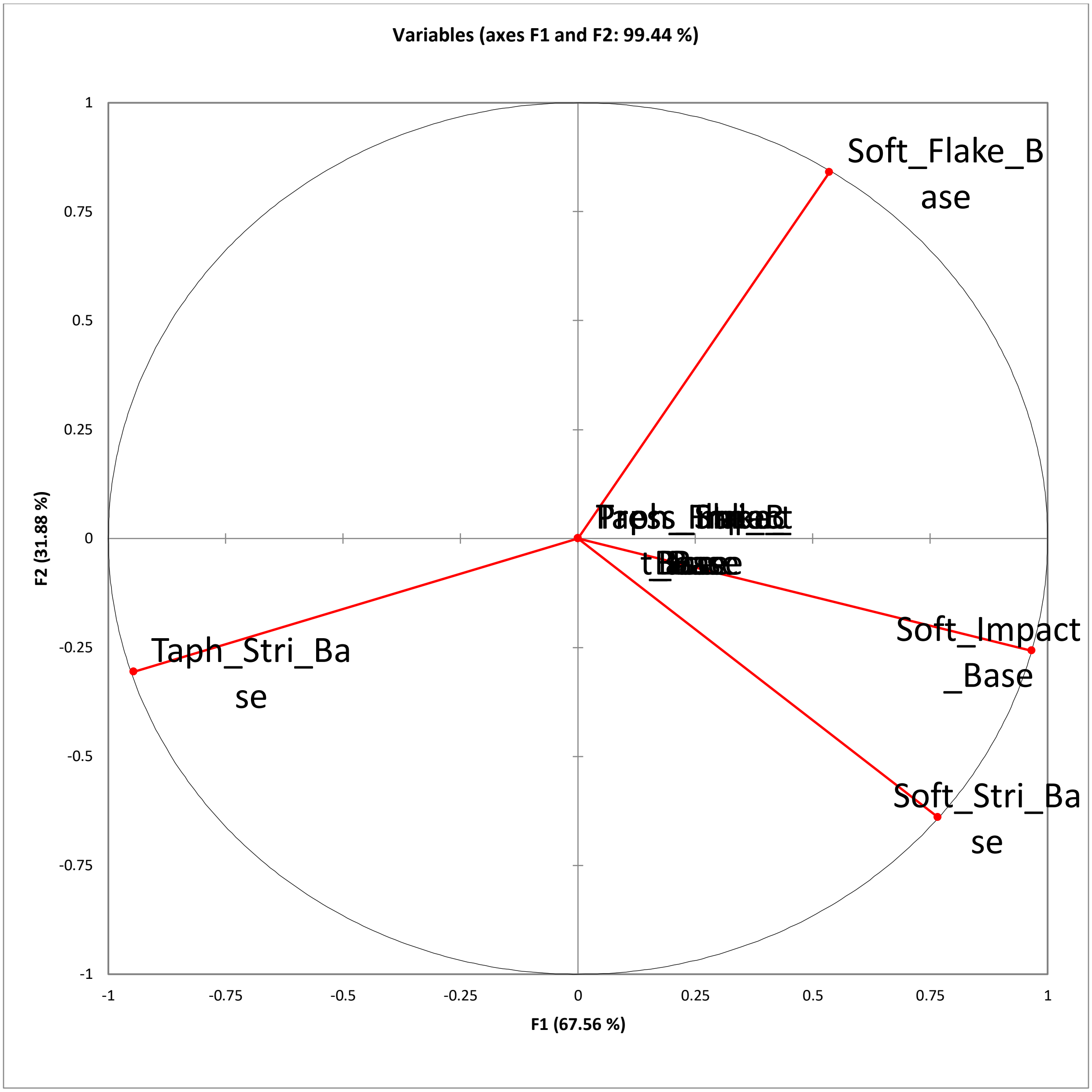


Figure 5.8. Antler Base PCA.

Regarding the antler main beam, there does appear to be a distinct, but unsurprising, pattern. Only taphonomic striations appear to be clustered at any significant frequency in this location on the antler (Figure 5.9). This pattern is important to note, since impact fractures and flake scars on this area of the antler might have likely been the result of human modification to the antler resulting from the removal from the antler. Thus, when it comes to examining human removal of antlers, the main beam is not necessarily a key area to examine.

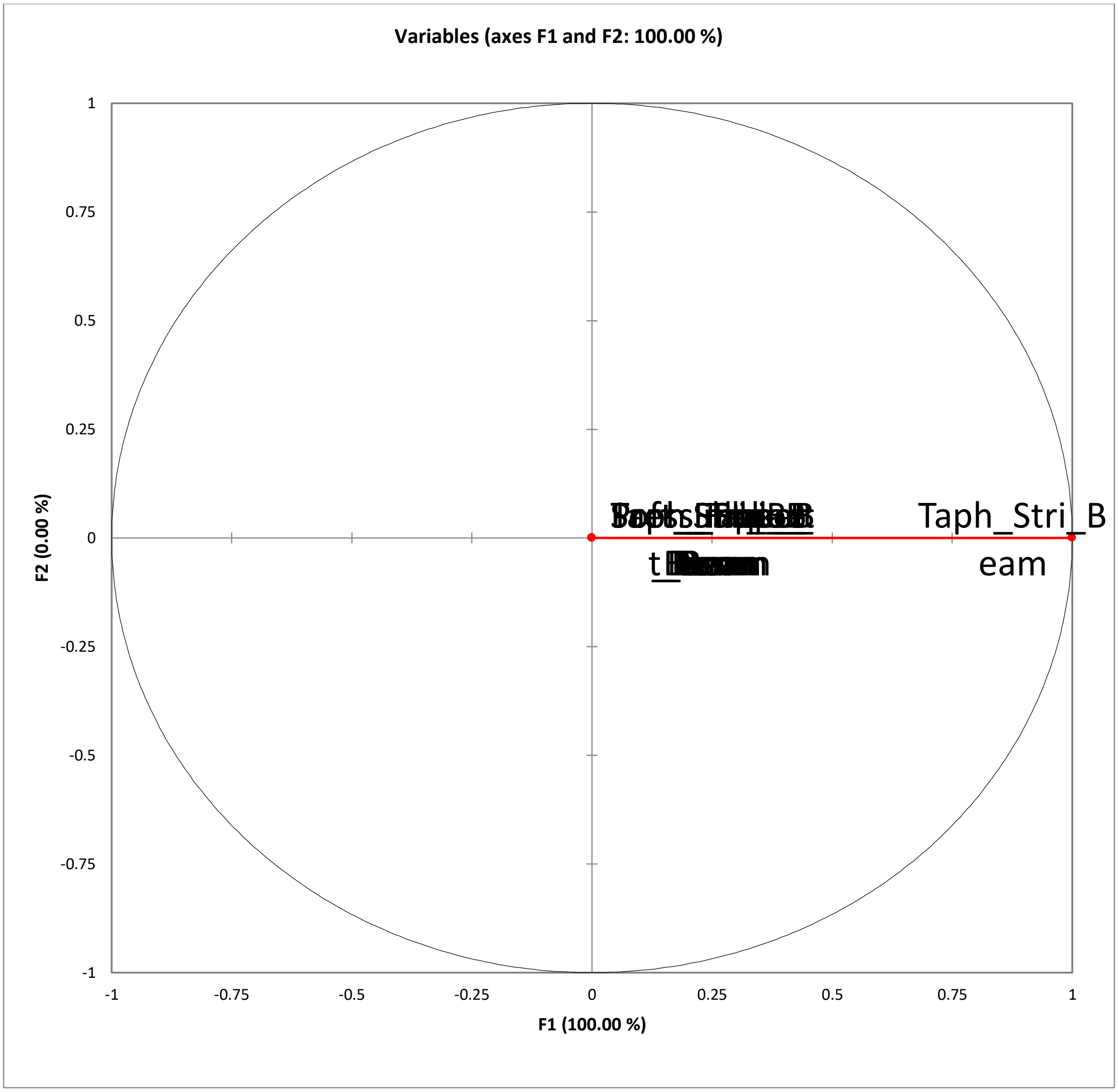


Figure 5.9. Main Beam PCA

Regarding the antler tines, there appears to be a set of patterns that reflect some issues regarding worked antler studies (Figure 5.10).

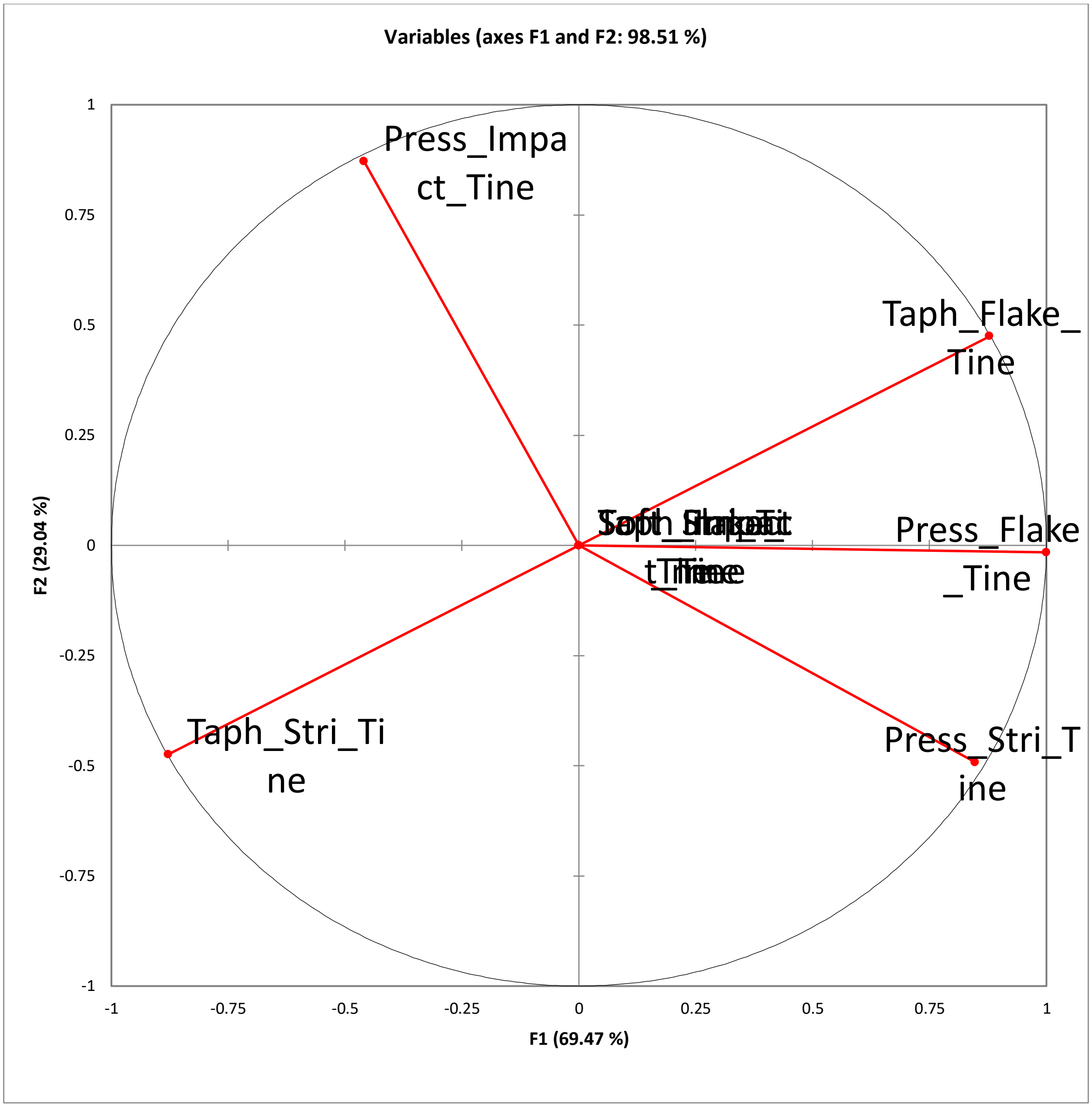


Figure 5.10. Antler Tine PCA

First, it is important to note the unsurprising pattern that soft-hammer percussion does not appear to damage antler tines. The more difficult pattern to disentangle is that pressure flaking and taphonomy leave distinct, but not necessarily confidently distinguishable, damage patterns on antler. Taphonomic damages include striations and flake scars, while pressure flaking exhibits patterns of striations, flake scars, and impact fractures. Although the PCA plot differentiates pressure flaking impact fractures and taphonomic striations on tines, the sample size is too small to provide a reliable pattern for real-world applications. However, the results do demonstrate the need to be conservative in determining antler tine modifications, especially if a broken tine is all that is recovered archaeologically.

Analytical Methods

Number of Specimens (NSP)

NSP is the total number of specimens present in an assemblage and is calculated by combining total counts of specimens. A specimen for this analysis includes all fragments of bone, shell, antler, horn, and tooth from the study samples. This basic sample size can be used to in some inter-site comparisons-, such as the general taphonomy at sites, thermal alteration or fragmentation size patterns at a larger scale as well as in comparison proportions with NISP values.

Fish scales are not included in the NSP values; as individual scales were not counted. Scales were weighed, bagged, and tagged by provenience separately from fish bones. Samples of 100 scales were counted and weighed. This number was then used to calculate a very rough estimate of fish scales for all contexts at all sites. The use of this rough fish scale NSP is useful for discussing general taphonomy in relation to site preservation, since fish scales being very fragile in nature, are a good indicator of preservation. An exception to this assertion was the distinctive long-nose gar scales, which are more durable and very distinctive in morphology. Both sets of fish scale NSP values are used to discuss recovery and taphonomy at the sites. Future research on the identification of fish genus or species based on the recovered scales, or season of capture may be conducted, but that is beyond the scope of this dissertation.

Number of Identified Specimens (NISP)

NISP is the total number of identified specimens, and is a common method used for estimating taxonomic abundance (Lyman 2008). It is calculated by summing the total specimens identified to class, family, genus, and/or species. NISP is primary raw data. It is not a continual count, but each is a discrete number (as opposed to weights- where rounding occurs), and therefore is amenable to a variety of statistical analyses (see Lyman 1979, 1994a, b). Additionally, NISP allows for inter-site and intra-site comparisons, as this is a standard zooarchaeological reporting calculation.

Advantages to NISP are that it can be quantified easily and quickly during the actual data collection process; the analyst therefore does not need to recalculate the NISP for every additional context added to the study (Lyman 2008:28). However, NISP can be affected by inter-analyst biases based on experience and training, as well as the available comparative skeletons available. One could create two different NISP quantifications among two analysts on the exact same faunal assemblage. Lyman (2008) compiled a list of eleven further disadvantages to using NISP:

1. NISP varies inter-taxonomically because different taxa have different frequencies of bones and teeth (the number of elements that are identifiable varies inter-taxonomically)

2. NISP will vary with variation infertility (number of off-spring per reproductive event) and fecundity (number of reproductive events per unit of time)

3. NISP is affected by differential recovery or collection (large specimens [of large organisms] will be preferentially recovered relative to small specimens [generally of small organisms])

4. NISP is affected by butchering patterns (different taxa are differentially butchered, one result of which is inter-taxonomic differential accumulation of skeletal parts, and another of which is inter-taxonomic differential fragmentation of skeletal elements)

5. NISP is affected by differential preservation (like problem 4) taphonomic influences may vary inter-taxonomically)

6. NISP is a poor measure of diet (the bones of one elephant provide more meat than the bones of one mouse)
7. NISP does not contend with articulated elements (is each tooth in a mandible tallied as an individual specimen, plus the mandible itself tallied?)
8. The problems identified may vary between strata within a site, between distinct sites, or both, rendering statistical comparison of site or stratum specific assemblages invalid
9. NISP may differentially exaggerate sample sizes across taxa
10. NISP may be an ordinal scale measure and if so, some powerful statistical analyses are precluded as are some kinds of inferences
11. NISP suffers from the potential interdependence of skeletal remains

Despite these disadvantages to using NISP, the advantage of comparability and standard of NISP in zooarchaeological reporting outweighs these disadvantages. Further, many archaeological quantification methods are affected by equifinality, as are most of the above NISP disadvantages.

Bone and Shell Weights

Faunal specimens were all weighed to the nearest 0.01 gram per taxa per context. Like NSP and NISP, weights are a primary data and are often, although not always, reported in standard zooarchaeological reports. Bone weight has been used as a rough proxy for dietary contribution of taxa as protein resources (Lyman 2008; Reitz and Wing 2008). This proxy-based approach is based on the biological principal that the more muscle on an animal, the denser the bone necessary to frame the animal's body. However, weight is a continuous variable - it is not a discrete number. Therefore, it is not always the most appropriate variable for some statistical analyses (Lyman 2008).

Of note, while shell weights were recorded, they are not used in this analysis as a proxy for protein emphasis in the diet, since shellfish are invertebrates and the relationship between the animal and its shell or exoskeleton is not a good rough proxy for muscle density (Giovas 2009; Peacock 2000; Reitz and Wing 2008; Waselkov 1987). While previous zooarchaeological studies used to use shell weight as a dietary proxy and compared it with bone weights to determine vertebrate versus invertebrate resource utilization (Waselkov 1987), this proxy is no longer a standard comparison in zooarchaeology. This shift in methodologies has led to debates on best practices in comparing vertebrate and invertebrate assemblages in holistic zooarchaeological analyses (e.g., Peacock 2000). For this analysis, shell weight was recorded to inform inferences on watershed resource usage, site taphonomy, and the general utilization of shell by culture groups who engaged in shell-tempering groups and those using non-shell tempering ceramic production methods.

Minimum Number of Elements (MNE)- Minimum number of elements

The MNE value is used to quantify the lowest value of possible discrete body parts of an animal at a site. The MNE value is calculated using identified elements of each taxon. Analysts vary in what variables they include in MNE calculations. For this analysis, age, robusticity/size, anatomical overlap, and modification were included. For example, if there were two left femur fragments, one proximal and one distal, of the same approximate size, then these would be calculated as MNE=1. This same principal works for elements where there is only one in the body (e.g. sacrum).

MNE values are ordinal data, they are derived and ultimately linked to NISP. MNE calculations have been debated, especially regarding anatomical overlap, in the literature for decades (e.g., Brewer 1992; Grayson 1984; Lyman 1994, 2008; Marean et al. 2001; Marean et al. 2004; Monro and Bar-Oz 2004; Pickering et al. 2003; Wolverton 2002). MNE is subject to two issues that have been highlighted in the academic literature (see Lyman 2008). While these issues are also common to MNI values, they do not necessarily mean that this method is not useful, but instead highlight the necessity of methodological transparency.

1. MNE is a minimum value, therefore one, “cannot statistically compare two minimum values that might differentially range to some maximum value” (Lyman 2008:223)
2. MNE is influenced by, “skeletal completeness, skeletal parts, and fragmentation” (Lyman 2008:223).

MNE can be influenced by how an analyst decides to calculate and aggregate their data. For example, researchers might use strata or features as discrete MNE values to be totaled for a site-wide MNE, while another analyst might use all site-wide data to calculate one MNE, collapsing all strata and features into one large sample. In this scenario, the two analysts would likely calculate different site-wide MNE values, as they are using different aggregating methods for their calculations. Additionally, not all analysts take the same variables into account (e.g., sex, age, rusticity, anatomical overlap).

The minimum possible elements of a given animal can change in calculation depending upon the aggregation of discrete sample contexts (e.g., site-wide, per feature, per strata). Each analytical unit type or aggregation strategy has its own merits and is often based on the proposed research questions or archaeological contexts (e.g., Grayson 1984; Lyman 1994a; Marean et al. 2001; Munro and Bar-Oz 2004; Outram et al. 2005; Otárola-Castillo 2010; Ringrose 1993). This quantification step is not always reported by analysisists- making it often difficult to compare MNE values between analysts. However, this aggregation of analytical units is fundamental for comparability among assemblages where MNE values are reported. For this dissertation, MNE values were calculated per feature context and then summed for the entire site. This calculation allows for a multi-scalar examination of elemental distribution as well as an investigation into potential animal processing activity areas (e.g., butchering, cooking discard).

Minimum Number of Individuals (MNI)

MNI values are calculated based on MNE values. For elements where there is only one in the body, the analyst can look at MNI based on these elements as the discrete counts (e.g., axial vertebra); however, for sided elements (e.g., humerus, femur), the calculations are the sum of the highest number of elements on a particular side. For example, if there are three right femurs and two left femurs for white-tailed deer, then the MNI value would be calculated as MNI=3. Because MNI values are based on MNE values, the same issues that have been debated in calculated MNE values are also debated in calculating MNI. MNI values are the total skeletal minimum estimation, while MNE values are partial skeletal minimum estimates per taxa (see Domínguez-Rodrigo 2012; Fieller and Turner 1982; Gilber and Singer 1982; Klein and Cruz-Uribe 1984; Marshall and Pilgram 1993; Needs-Howarth 1995; O'Connor 2008; Ringrose 1993; Turner 1983).

In this analysis, as with MNE values, MNI values were calculated per feature and then totaled for a site-wide MNI. Both series of values are reported, thus allowing for inter-analyst comparisons in the future. Some animals may have had body parts distributed among different contexts as the result of processing and cultural habits (e.g., food sharing among households or different processing and cooking areas); the likelihood of carcass distribution across multiple feature contexts is most applicable to larger animals, such as deer. However, to maintain consistency in methodology, MNI and MNE values are calculated per feature context.

Estimating Vertebrate Biomass

Biomass based on allometric analysis and bone weights will be considered as an alternative to calculating usable meat based on MNI values, since allometric calculations using bones weights is determined from specimen weights. Therefore, quantities are based on what was recovered as opposed to inferred complete animals, sometimes represented by only a single element. However, Reitz cautions that “biomass estimates do not represent the total amount of meat consumed by the archaeological community, but instead reflect a sample of that total” (Reitz et al. 1987:307).

Biomass calculations were conducted based on the bone weights from animals in an entire feature. This data aggregation method was chosen because most features with multiple zones designated in the filed had bone refits between the zones. This entire-feature approach allows for the aggregation of screened and flotation materials, where there was no vertical control over the screened contexts to be combined. Additionally, without radiocarbon dates from contexts with vertical control (flotation samples), there is no way to know if feature deposition as seen in the strata are separated by days, months, years, or generations. Therefore, the aggregation of data for biomass was kept to the most conservative estimation possible. The following elements were excluded from biomass calculations:

- Horn
- Antler
- Fish scales

Horn and antler were likely maintained for their use in tool manufacture. Additionally, they do not contain meat. Antler and horn weights were excluded.

Fish scales were excluded, since there are so many on each fish, akin to counting the hairs on a dog, and would heavily bias the NISP sample (see discussion for bias in Davis 1987:36). During the descaling process or the creation of comparative collections, many scales are often lost, therefore it is not probable that every scale made it into the comparative collection box for study.

Reitz et al. (1987) warn that the use of allometric biomass as an estimate for dietary contribution generally under-represents the amount of meat weight per animal used by the past peoples. However, biomass is directly calculated from a combination of living animals, the results can be recalculated by any future researcher based on the data provided, as well as the direct use of the archaeological context bone weights, rather than an extrapolated number.

Calculated meat weight estimates using live animal average weights can be misleading and difficult if not impossible to replicate by other researchers. This ambiguity is often due to a combination of factors. Sometimes to calculate an estimated dietary emphasis of animals recovered archaeologically, researchers use a combination of MNI calculations and then calculate a potential meat weight estimate (Lyman 1979; Purdue 1987). Researchers sometimes rely on the reported average weight of animals as reported by state or national organizations (e.g., DNR), however these averages can change through the decades or from state-to-state (Purdue 1987). Therefore, these records are not necessarily comparable within a larger geographic region. Such reports do not always average in the juvenile or account for sexual dimorphism.

Archaeologically we can see a difference and often these are not able to be replicated in practice. Given our small bone fragments, it is not often possible to determine sex or age. The reliance on these reports can be difficult to determine the reliability does not get accounted for. The extrapolation of an entire bison’s body weight contribution based on a single phalanx can be reported, possibly overestimating the reliance of these large animals based on such an extrapolation. Further, the way in which MNI values are calculated are not always stated explicitly in the research reports or articles, and therefore even if a researcher used the same DNR reports, the meat weight estimations may be altered or not comparable due to a difference in MNI calculations.

In this research, bone weight is used since weight is not a derived measure and is comparable to most research reports. MNI calculations were calculated to keep the data comparable with other researchers. However, it is fair to acknowledge the advantages to using MNI and average animal weight estimations:

1) Easy to teach new zooarchaeologists and students
2) Less time consuming
3) Use publicly available online resources
4) Not reliant on extensive comparative collections necessary for bone weights associated with live animal weights

Assessing Local and Non-Local Habitat Exploitation

When utilizing these ecological niches for the purposes of investigating local or non-local animal resource acquisition, categories are collapsed, and specific animals are used to test the exploitation patterning between sites and localities. Village sites are specifically compared, since mortuary-related sites and site areas do not necessarily represent a baseline for typical dietary strategies.

Forest is used as a model category but was not represented in any of the 2km catchments surrounding the site areas. Therefore, animal favoring forest habitats represent animals necessitating coordinated hunting ventures or were opportunistic kills further from the immediate site area. As such, these animals represent one end of the OFT spectrum- animals hunted if the threat of systemic violence is not a consistent reality or mitigating factor in protein resource acquisition.

Savanna soils are the most arable in the site areas (see Edwards 2010). As such, these patches represent areas where agricultural fields and gardens were most likely placed. These patches represent the opposite end of the spectrum as being close to the site areas and were likely opportunistic kills (traps laid by gardens and fields or hunted as pest maintenance). Additionally, wetland, lake/river, and creek niches are combined as an all-encompassing water-edge category.

Water-edge resources represent relatively local patches to the villages. By keeping water and field edge niches separate, the distinction between resource acquisition and difference in proportion of the 2km catchment model areas can be accounted for.

These environmental niches are compared with the biomass proportions of animals who are habitually known to favor these environments. The following animals are used to compare habitat niche exploitation at the village sites.

- Forest: bear, elk, fox
- Field-edge: raccoon, turkey, rabbit
- Water-edge: waterfowl, fish, muskrat, otter, fisher, beaver

Deer are excluded from this comparison, since they can be hunted along field edges and forests, and thus their exclusion prevents double-counting.

Assessing Potential Deer Hunting Strategies

Two themes for investigating white-tailed deer hunting strategies within each site assemblage are used: local versus non-local hunting and age-selective or non-selective hunting. In an OFT scenario, where there was not the threat of systemic violence then we would expect for hunters to be engaging in coordinated hunting pursuits and targeting prime-age deer (ages 2.5-5 years). If violence was not a consideration, then there would not be factors mitigating the aquisiton of these larger meat packages and bringing them back to the site. As such, we should be able to see if the study site assemblages meet expectations of general OFT modeling (no violence) or OFT models with violence (see chapter 2). Additionally, we can compare to see if Oneota or Langford groups had different hunting strategies or if cultural tradition did not play a role in hunting patterns.

Local and non-local deer hunting is addressed by comparing proportions of MNE values for body parts in the following categories: cranial, axial, upper limb and lower limb. A rough skeletal index is used to determine if hunting was more likely local or non-local. A ratio of expected proportions of cranial to upper limb elements is compared with the MNE data per site assemblage (e.g., 1 cranial element to every 2 upper limb element). Binford (1977) indicated that evidence of local hunting should result in more non-economically productive elements being present within the general village area, since carcasses would be processed locally, and larger body part transfer would be easier. This is opposed to coordinated hunting trips where larger meat packages would be brought back to the habitation area over non-meat bearing elements (e.g., crania).

Age-selection or non-age selection hunting patterns are assessed by the comparison of deer elements which were able to be aged. The following age categories were used to compare: fawn, yearling, prime-age. These comparisons between age groups are dependent upon the number of deer elements which were able to be aged, which is fundamentally linked to the amount of fragmentation of the faunal assemblages.

6. Vertebrate Results

The results of the respective samples of vertebrate specimens are presented thematically, reporting the overall vertebrate assemblage fauna (e.g., general midden), then reporting worked fauna (e.g., tools, adornment), and ritually deposited fauna (e.g., dog burials). For reporting the overall assemblage and subsistence data, each site assemblage is reported individually and assessed within the context of its respective locality. The worked fauna and ritually deposited faunal contexts were recovered from the Lake Koshkonong Locality, but not recovered within the samples from the Fox/Des Plaines Locality. Thus, a direct comparative analysis between localities is not possible with these samples. However, the theme of worked fauna and ritually deposited fauna are discussed in Chapter 10 within a broader Oneota and Langford contexts to discuss the human-animal-environmental relationship.

Langford Fox/Des Plaines Locality

The vertebrate assemblages analyzed for the Fox/Des Plaines locality show a pattern of upland game hunting and a difference in ecological niche exploitation. These differences between the Washington Irving and Robinson Reserve site assemblages correspond with different expectations for village and mortuary encampment sites. However, both site faunal assemblages follow the general Langford expectation for an emphasis on upland hunting (see Emerson et al. 2010; Hunter 2002; Jeske 1990, 2003).

Washington Irving

A total of 27,728 vertebrate specimens, weighing 2706.68 grams were recovered from the Washington Irving site, of which 4,872 were identifiable to taxonomic class (Table 6.1). The high amount of unidentifiable vertebrate remains is due to the high amount of bone fragmentation. Within the identified sample, mammals are the predominant taxonomic class within the assemblage, followed by fish, bird and reptile. This emphasis on mammal remains at Washington Irving follows the expectations set up by previous faunal analyses using the same dataset conducted by Hunter (2002) and Yerkes (1985). The undifferentiated mammal size-categories indicate a reliance on large mammals (46.34%). These may represent members of the genus *Cervidae* (e.g., deer), as was previously identified by both Hunter (2002) and Yerkes (1987).

Table 6.1. Washington Irving Class Summary Data

Identification	**NSP**	**Proportion**	**Weight (g.)**	**Proportion**
Identified	4,827	17.41%	1055.24	38.99%
UNID	22,901	82.59%	1651.44	61.01%
Total	***27,728***	***100.00%***	***2706.68***	***100.00%***
Taxonomic Class	**NISP**	**Proportion**	**Weight (g)**	**Proportion**
Fish	1,748	36.21%	158.13	14.99%
Bird	553	11.46%	44.06	4.18%
Mammal	2,332	48.31%	751.22	71.19%
Reptile	194	4.02%	101.83	9.65%
Amphibian	0	0.00%	0	0.00%
Total	***4,827***	***100.00%***	***1055.24***	***100.00%***
Undifferentiated Mammal Size Categories	**NISP**	**Proportion**	**Weight (g.)**	**Proportion**
Class I Mammal	18	1.35%	4.48	1.83%
Class II Mammal	21	1.57%	12.05	4.91%
Class III Mammal	14	1.05%	18.79	7.66%
Class III/IV Mammal	33	2.47%	32.61	13.29%
Class IV Mammal	482	36.08%	113.74	46.34%
Class X Mammal	1,068	79.94%	63.77	25.98%
Total	***1,636***	***122.46%***	***245.44***	***100.00%***

While the faunal assemblage indicates a reliance on both mammal and fish, the reliance on fish is unsurprising since the site is located adjacent to a wetland and seasonal slough, where aquatic resources should have been readily available. This reliance on large mammals perhaps relates to the previously asserted Langford preference for upland game when compared with contemporaneous Oneota and Late Woodland groups (Berres 2002; Craig and Galloy 1996; Emerson 1999; Emerson et al. 2010; Jeske 1989, 2003).

When comparing an overall dietary emphasis within the site assemblage, the calculated biomass helps to illuminate the fish-mammal distinction, as well as the distinctions between mammal size categories (Table 6.2). Biomass data shows a much higher emphasis on mammal protein than any other taxonomic class. However, as opposed to NISP values, bird is almost twice the biomass as fish. This difference between NISP and biomass is due to the differences in fish genus type and the amount of estimated mass they naturally yield (e.g., catfish vs. minnows). Most birds at in the Washington Irving assemblage are identified as waterfowl, and therefore would yield higher amounts of meat per animal than some of the fish species identified (e.g., bluegill, pumpkinseed).

Table 6.2. Washington Irving Summary Biomass Data

Taxa	**Biomass (g)**	**Proportion**
Mammal	2,618.2	85.40%
Bird	259.2	8.45%
Fish	138.04	4.50%
Reptile	50.39	1.64%
Undifferentiated Mammal Sizes		
Class I	5.57	0.41%
Class II	233.80	17.30%
Class III	237.90	17.60%
Class III/IV	292.95	21.67%
Class IV	292.95	21.67%
Class X	288.40	21.34%

Species Summary Data

The species summary data excludes the undifferentiated class specimens to better compare the species present within the faunal assemblage. Overall, the Washington Irving faunal assemblage shows an emphasis on white-tailed deer (63% of genus/species sample biomass) (Table 6.3). The genus/species sub-sample shows a better picture of the dynamics between upland hunting and wetland resource acquisition at the site. Some of the medium-sized mammals identified to genus and species show a reliance on fauna easily trapped or hunted in wetland areas (e.g., raccoon, muskrat, beaver). Further, waterfowl and fish would have been exploited along the nearby wetlands. The biomass comparison of wetland to upland hunting resources if using this sub-sample of the assemblage shows a split between these ecozones, rather than the very high emphasis on upland hunting asserted by Hunter's preliminary faunal analysis (Hunter 2002) (Figure 6.1). Upland hunting and terrestrial animals are still more emphasized than wetland or aquatic fauna, but not to an unexpected degree given the village's close proximity to a large series of wetlands.

Table 6.3. Washington Irving Species Summary Data

TAXA	NISP	Proportion	Weight (g)	Proportion	Biomass (g)	Proportion
MAMMALIA (Mammals)						
Artiodactyla	13	0.41%	14.05	1.73%	17.48	1.01%
Cervidae	134	4.20%	59.79	7.39%	73.16	4.24%
cf. Bison bison (bison)	1	0.03%	3.47	0.43%	4.44	0.26%
Odocoileus virginianus (white-tailed deer)	469	14.70%	378.91	46.79%	1103.35	63.90%
Carnivora						
Canidae (dog, wolf)	13	0.41%	5.57	0.69%	6.93	0.40%
Vulpes						0.00%
Vulpes vulpes (red fox)	1	0.03%	1.15	0.14%	1.1	0.06%
Procyonidae						0.00%
Procyon lotor (raccoon)	3	0.09%	3.67	0.45%	4.57	0.26%
Undifferentiated Carnivora	2	0.06%	1.18	0.15%		0.00%
Lagomorpha (hares, rabbits)						0.00%
Leporidae (cottontails)						0.00%
Sylvilagus						0.00%
Sylvilagus floridanus (eastern cottontail)	2	0.06%	1.08	0.13%	1.34	0.08%
Rodentia						0.00%
Castoridae	12	0.38%	6.58	0.81%		0.00%
Castor (beavers)						0.00%
Castor canadensis (American beaver)	12	0.38%	10.47	1.29%	13.03	0.75%
Cricetidae						0.00%
Ondatra (muskrats)						0.00%
Ondatra zibethicus (common muskrat)	6	0.19%	5.58	0.69%	5.5	0.32%
Sciuridae (squirrel, chipmunk)						0.00%
Sciurus (tree squirrels)						0.00%
Sciurus carolinensis (gray squirrel)	8	0.25%	3.67	0.45%	45.67	2.64%
Tamias	3	0.09%	1.15	0.14%		0.00%
Tamias striatu (eastern chipmunk)	1	0.03%	0.87	0.11%	1.08	0.06%

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Cervidae	134	4.20%	59.79	7.39%	73.16	4.24%
cf. Bison bison (bison)	1	0.03%	3.47	0.43%	4.44	0.26%
Odocoileus virginianus (white-tailed deer)	469	14.70%	378.91	46.79%	1103.35	63.90%
Carnivora						
Canidae (dog, wolf)	13	0.41%	5.57	0.69%	6.93	0.40%
Vulpes						0.00%
Vulpes vulpes (red fox)	1	0.03%	1.15	0.14%	1.1	0.06%
Procyonidae						0.00%
Procyon lotor (raccoon)	3	0.09%	3.67	0.45%	4.57	0.26%
Undifferentiated Carnivora	2	0.06%	1.18	0.15%		0.00%
Lagomorpha (hares, rabbits)						0.00%
Leporidae (cottontails)						0.00%
Sylvilagus						0.00%
Sylvilagus floridanus (eastern cottontail)	2	0.06%	1.08	0.13%	1.34	0.08%
Rodentia						0.00%
Castoridae	12	0.38%	6.58	0.81%		0.00%
Castor (beavers)						0.00%
Castor canadensis (American beaver)	12	0.38%	10.47	1.29%	13.03	0.75%
Cricetidae						0.00%
Ondatra (muskrats)						0.00%
Ondatra zibethicus (common muskrat)	6	0.19%	5.58	0.69%	5.5	0.32%
Sciuridae (squirrel, chipmunk)						0.00%
Sciurus (tree squirrels)						0.00%
Sciurus carolinensis (gray squirrel)	8	0.25%	3.67	0.45%	45.67	2.64%
Tamias	3	0.09%	1.15	0.14%		0.00%
Tamias striatu (eastern chipmunk)	1	0.03%	0.87	0.11%	1.08	0.06%

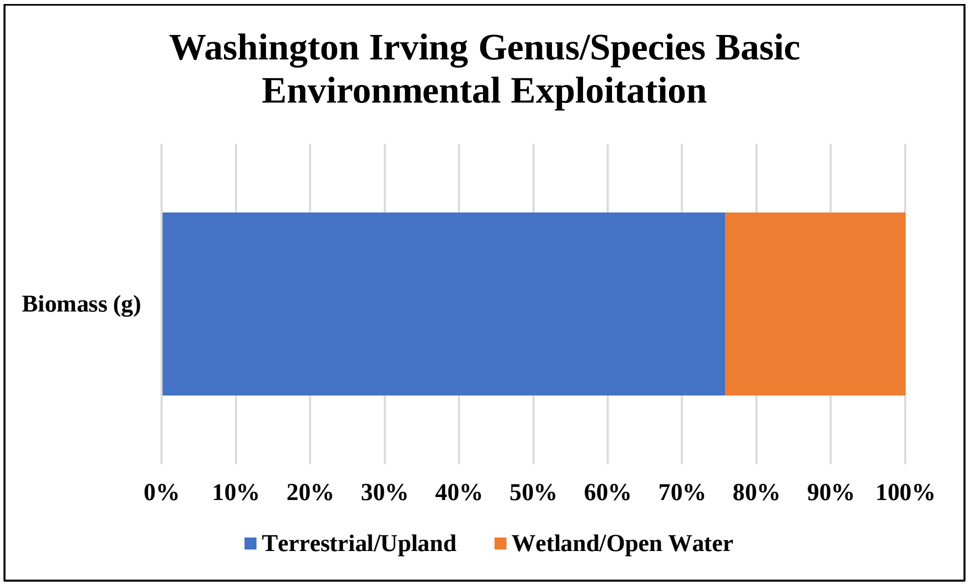

Figure 6.1. Washington Irving Genus/Sp. Environmental Exploitation.

Waterfowl would have favored the reedy wetlands near the site for seasonal nesting. Therefore, these birds may have provided a local and semi-reliable resource for meat, hollow bones for manufacture (e.g., beads, needles), and feathers for adornment and manufacture (e.g., dart and arrow fletching, ceremonial pipes, adornment) (Hall 1997; Murray 2011).

The fish specimens recovered at Washington Irving show the acquisition of a suite of aquatic resources. These fish may have been captured by a series of different fishing techniques (e.g., net weirs, hook-and-line) (Jeske and Hart 1988), and may have been acquired by Jelkes Creek, which runs through the wetlands near the site. This slough would have been inhabitable for the smaller fish species, and the nearby Fox River would have been a useful resource for acquiring the larger and more varied species of fish inhabiting deep, shallow, clear, and vegetative water. Cultural factors possibly influencing the differential representation of fish species at Langford sites can be summarized in three broad, non-mutually exclusive, categories:

1) Method of capture (e.g., net weirs, hook and line, harpoon fishing)

2) Differences in cooking (e.g., smoking, salting, boiling/soup or stew)
3) Waste disposal (e.g., dogs scavenging, use of trash for fuel, off-site dumps)

Many of the reptile remains were turtle carapace and plastron fragments. These have been used by Native American groups in the region for bowls, storage, ceremonial rattles, or another artifact type (see Hall 1997; Overstreet 1997; Skinner 1921).

It is important to note the variety of fish species, as well as the distinction between the estimated biomass of recovered fish remains. The inhabitants at Washington Irving likely used a series of different fish capture techniques and were not targeting a single size. Given the very close proximity of Jelkes Creek, it is possible that the site occupants were using both hook and line as well as net weirs. Thus, they would have maximized their potential protein recovery during time spend in the wetlands or along the Fox River.

Deer Sub-Sample

Since deer present the largest protein resource and emphasis within the site assemblage, the question of local or non-local hunting must be addressed. Local hunting is often associated with the presence of elements of a larger animal that would not be economical to transport longer distances between hunting grounds and a habitation area (Binford 1977). As such, MNE values for deer bones are compared as larger body parts of meat packages present within the assemblage.

A high proportion of the deer elements recovered from the site belong to the axial part of the skeleton (i.e., ribs, sternebrae, vertebra) (Table 6.4, Figure 6.2).

Table 6.4. Washington Irving Deer Body Parts.

Body Parts	**NISP**	**Proportion**	**MNE***	**Proportion**
Cranial	39	8.32%	10	4.52%
Axial	109	23.24%	33	14.93%
Upper Limb	55	11.73%	27	12.22%
Lower Limb	266	56.72%	151	68.33%
Total	469	100.00%	221	100.00%

*MNE includes antler

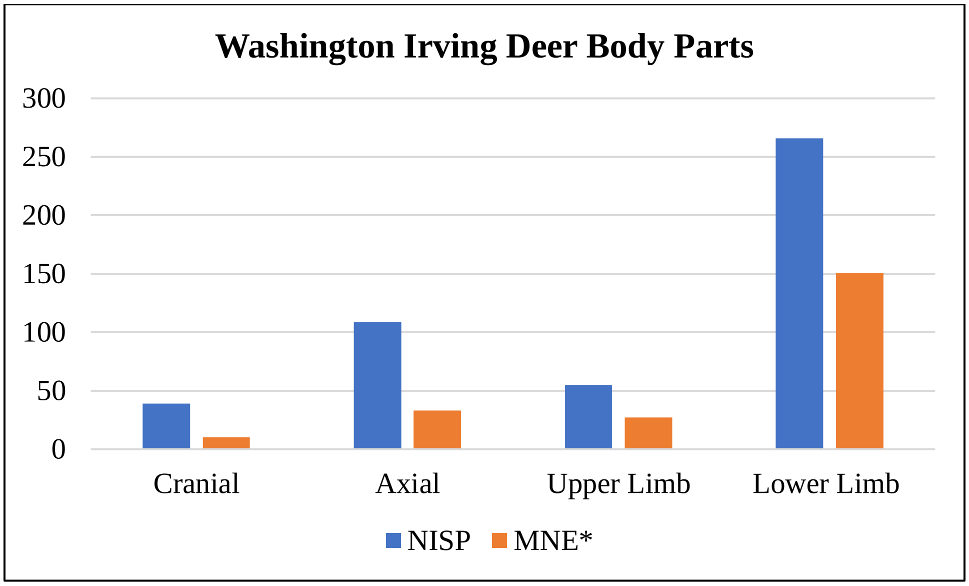

Figure 6.2. Washington Irving Deer Body Parts

In this case, it is not easily distinguished if local or non-local hunting was occurring at the site. There is a relatively low amount of cranial elements present, which is expected for meat package transportation. However, there is also a high amount of lower limb elements. Lower limbs (phalanges, metapodials) are associated as yielding the highest amounts of bone marrow, which makes them attractive for groups under nutritional stress (Bindford 1977).

Binford (1977) has also nicknamed these elements as “riders” (Binford 1978:49-59). These elements may not yield as much meat as the upper limbs or haunches but are transported back to a habitation area as part of the larger meat package, essentially riding along. Given the relatively large difference between upper and lower limb elements (both NISP and MNE values), it is possible that there was a combination of local and non-local hunting occurring at Washington Irving. As such, site occupants may have chosen to utilize lower limb elements for their marrow.

When comparing the proportion of cranial elements to upper limb elements, there is a 10:27 proportion of MNE values. When assuming one cranial element per upper limb element, this ratio seems unclear, but is more likely indicative of local hunting and processing. Local hunting and processing of deer may indicate a preference for hunting near agricultural fields or the use of nearby forest-edge habitats. In such cases, hunting is opportunistic, while hunting groups leaving the site and returning, and exploiting forest and forest-edge areas would require a coordinated effort. A strategy of local hunting and processing alongside coordinated hunting efforts, suggests a focused dietary preference that correlates with the higher ranked resources predicted by Optimal Foraging Models- where groups would make decisions based on the largest caloric return for the most efficient effort exerted (Broughton 2002; Hawkes et al. 1982; Smith et al. 1983; Pyke 1984).

In the case of deer as an energy investment in procurement, their benefits are high. Deer provide dense bone for tools, large cuts of meat, as well as marrow and bone grease that can be extracted, along with hides for shelter and clothing. In this manner, while hunting efforts, both opportunistic and coordinated may carry less-guarantee than fishing or trapping of medium mammals, the overall resource utility for a deer is higher. Therefore, the trade-off with energy expenditure and potential risk during coordinated hunting trips, risking other rival groups in the area, was possibly worth it. During garden-side hunting events, the risk of rival or hostile groups is minimized, and the labor investment for agricultural and defensive pursuits remains steady. Additionally, stable isotope studies on human skeletal remains and domesticated dogs using the canine-surrogacy approach show that Langford groups were consuming similar levels of maize as Middle Mississippian groups within the American Bottom (see Edwards 2017; Emerson et al. 2005; Emerson et al. 2010). The isotopic evidence for such a high reliance on maize agriculture indicates the increased possibility that opportunistic hunting along field edges may have been utilized more often and been more economical than relying primarily on coordinated hunting efforts further from the village.

Deer Mortality Profiles

Of the deer elements able to be aged, those at Washington Irving all represent prime-age or yearling deer (Table 6.5). Given the very small sample of deer elements able to be aged, these results are tentative. Prime-age deer and yearlings would have provided enough meat to provide a larger amount of protein per meat package. Therefore, it appears the site occupants were either targeting only adult deer to save fawns and yearlings for future hunting endeavors, or these younger animals were so thoroughly processed that they were not preserved archaeologically.

Table 6.5. Washington Irving Deer Age Mortality Profiles

Deer Age Mortality Profiles		
Elements	**Age Range**	**NISP**
Humerus, Prox- fused	26-38	1
Femur, Prox- fused	20	1
Femur, Dist- fused	23-29	1

Washington Irving Summary

Overall, the Washington Irving vertebrate assemblage shows a high emphasis on deer, with some inclusion of wetland and aquatic animals. Jeske (1990, 2000) and Hunter (2002) have argued for an emphasis of upland hunting with some wetland exploitation as buffering resources at Washington Irving. Jeske (1990, 2000) argued that Washington Irving occupants were exploiting their local environment and economized on lithic resources in favor of other pursuits, such as subsistence pursuits (e.g., agriculture, hunting). Both Hunter and Jeske’s conclusions are supported by this analysis.

Given the close proximity to Jelkes Creek, it is surprising that there was not more reliance on wetland resources. Adult deer were primarily targeted, meaning the site residents hunted seasonally when the deer would be at their largest and did not regularly take fawns or yearlings. While there is a high degree of thermal alteration and fragmentation at the site, when examining the sub-sample of deer bones, it is possible that the fragmentation on mammal bones is a byproduct of marrow and/or grease extraction. Thus, site inhabitants may have been maximizing the uselife of animal resources once acquired.

In the case of Washington Irving, the site occupants were maximizing their local resources. Paleobotantical data and isotopic evidence indicates that Langford groups were heavily relying on maize agriculture (Edwards 2017; Emerson et al. 2005; Emerson et al. 2010). Since the Washington Irving site occupants were utilizing both nearby wetland resources (e.g., muskrat, fish) and animals that would have been attracted to agricultural fields (e.g., deer, raccoon), site occupants were focusing their faunal exploitation on their local resources.

Robinson Reserve

Class NISP and Weights

A total of 4,522 vertebrate specimens, weighing 5,188.64 grams were recovered from the Robinson Reserve site, of which 4,373 were identifiable to class (Table 6.6). The overall faunal sample size is comparable to Washington Irving. Like Washington Irving, mammal is the predominate taxonomic class identified within the Robinson Reserve assemblage. However, the second highest represented resource, fish, consist of only 46 bones. Majority of the vertebrate assemblage was identified to taxonomic class (96.7%), therefore the lack of mammal remains is not necessarily due to a high amount of fragmentation yielding unidentifiable specimens.

Table 6.6. Robinson Reserve Class Summary Data

Identification	**NSP**	**Proportion**	**Weight (g.)**	**Proportion**
Identified	4,373	96.70%	5,126.57	98.80%
UNID	149	3.30%	62.07	1.20%
TOTAL	4,522	100.00%	5,188.64	100.00%
Taxonomic Class	**NISP**	**Proportion**	**Weight (g)**	**Proportion**
Fish	46	1.05%	3.96	0.08%
Bird	18	0.41%	11.05	0.22%
Mammal	4,293	98.17%	5,097.34	99.43%
Reptile	16	0.37%	14.22	0.28%
Amphibian	0	0.00%	0	0.00%
TOTAL	4,373	100.00%	5,126.57	100.00%
Undifferentiated Mammal Size Categories	**NISP**	**Proportion**	**Weight (g)**	**Proportion**
Class I Mammal	4	0.09%	2.33	0.06%
Class II Mammal	3	0.07%	10.42	0.27%
Class III Mammal	16	0.37%	31.04	0.80%
Class III/IV Mammal	40	0.93%	78.98	2.03%
Class IV Mammal	120	2.80%	578.47	14.88%
Class X Mammal	4,110	95.74%	3,186.21	81.96%
TOTAL	4,293	100.00%	3887.45	100.00%

When examining the undifferentiated mammal remains, the majority were unable to be conservatively assigned a size category (95.7%), therefore it is difficult to ascertain if large mammal were highly represented beyond those identified to genus or species. The emphasis on mammal predominance at Robinson Reserve is further reflected in the estimated biomass calculations (Table 6.7). Mammal makes up 99.08% of the overall estimated biomass in the vertebrate assemblage. Thus, the animal protein at Robinson Reserve comes almost exclusively from mammals. Of the undifferentiated mammal specimens, most of the biomass comes from the un-sized mammal fragments (Class X). This pattern may represent mammal bone processing for bone marrow or grease extraction.

Table 6.7. Robinson Reserve Class Biomass Summary Data

Taxa	**Biomass (g)**	**Proportion**
Mammal	7,115	99.08%
Bird	21	0.29%
Fish	13	0.18%
Reptile	33	0.46%
Undifferentiated Mammal Sizes		
Class I	4.79	0.09%
Class II	19.50	0.37%
Class III	55.78	1.07%
Class III/IV	133.10	2.56%
Class IV	894.96	17.21%
Class X	4,091.90	78.69%

Species Summary Data: NISP, Bone Weight, Biomass

The species present at Robinson Reserve shows an emphasis on locally available upland game (e.g., deer) as well as some aquatic animals (e.g., muskrat, waterfowl, turtle). (Table 6.8). Of the vertebrate remains identified to genus or species, there is a very high emphasis on large mammals. Deer are the dominant animal represented in the assemblages. Deer are not an ecozone-specific resource, unlike elk or bison (Pauley et al. 1993). Deer would be available resources for hunting locally or alongside field edges.

The high proportion of muskrat results from as trapping alongside the river or nearby wetlands. Muskrats are a medium-sized mammal which could have provided both fatty protein and pelts. Trapping have easily been conducted in both an economic and efficient manner. Traps can be set and left out overnight, so only one trip is necessary to check traps to and from watershed areas. As the site is located right on the Des Plaines River, it is odd that these groups did not take full advantage of fish that would have been easily obtained from the river. The nearby Des Plaines River would have provided an ideal habitat for muskrat trapping, along with the targeting of larger fish (e.g., gar, lake sturgeon, catfish). The fish that are represented within

Table 6.8. Robinson Reserve Species Summary Data

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass (g)	Proportion
MAMMALIA (Mammals)						
Artiodactyla						
Cervidae	34	5.07%	62.05	5.01%	109.53	5.53%
cf. *Bison bison* (bison)	1	0.15%	6.46	0.52%	11.98	0.60%
Odocoileus virginianus (deer)	316	47.09%	841.79	67.93%	1249.65	63.07%
cf. *Odocoileus virginianus*	54	8.05%	89.38	7.21%	162.54	8.20%
cf. *Cervus canadensis* (elk)	7	1.04%	14.99	1.21%	27	1.36%
Carnivora						
Ursus americanus (bear)	1	0.15%	4.21	0.34%	8.15	0.41%
cf. *Ursus americanus* (bear)	1	0.15%	2.33	0.19%		0.00%
Canidae (dog, wolf)	6	0.89%	16.61	1.34%	31.82	1.61%
cf. *Canidae*	2	0.30%	8.32	0.67%	15.04	0.76%
Procyonidae	7	1.04%	9.05	0.73%	16.83	0.85%
cf. *Procyon lotor* (raccoon)	1	0.15%	1.04	0.08%	2.32	0.12%
cf. *mephitis* (skunk)	1	0.15%	0.98	0.08%	2.19	0.11%
Undifferentiated Carnivora	1	0.15%	4.02	0.32%	7.82	0.39%
Didelphimorphia						
Didelphidae (American opossum)	1	0.15%	2.76	0.22%	5.57	0.28%
Rodentia						
Castor canadensis (beaver)	5	0.75%	6.33	0.51%	12.31	0.62%
Ondatra zibethicus (muskrat)	140	20.86%	127.93	10.32%	229.9	11.60%
cf. *Ondatra zibethicus* (muskrat)	4	0.60%	3.28	0.26%	6.51	0.33%
Sciuridae (squirrel, chipmunk)						
Sciurus (tree squirrels)	5	0.75%	3.71	0.30%	6.51	0.33%
Geomys sp. (gopher)	1	0.15%	1.73	0.14%	3.66	0.18%
Unknown Rodentia	3	0.45%	2.92	0.24%	5.86	0.30%
TOTAL	**591**	**88.08%**	**1,209.89**	**97.64%**	**1915.2**	**96.66%**
AVES (birds)						

Taxa	**NISP**	**Proportion**	**Weight (g.)**	**Proportion**	**Biomass (g)**	**Proportion**
Anseriformes (waterfowl)						
Anatidae (goose, duck)						
Anas platyrhynchos (mallard)	4	0.60%	3.12	0.25%	6.37	0.32%
Rallidae (coots, rails, waterhens)						
cf. *Fulcra americana* (coot)	1	0.15%	1.09	0.09%	2.24	0.11%
Columbiformes (pigeon, dove)						
Ectopistes migratorius (passenger pigeon)	2	0.30%	1.41	0.11%	2.34	0.12%
Unknown Aves	11	1.64%	5.43	0.44%	9.92	0.50%
TOTAL	**18**	**2.68%**	**11.05**	**0.89%**	**20.86**	**1.05%**
OSTEICHTHYES (Fish)						
Ictaluridae (catfish)						
Ameiurus spp. (bullhead)	3	0.45%	0.58	0.05%	1.02	0.05%
Ictalurus punctatus (channel catfish)	9	1.34%	0.54	0.04%	0.97	0.05%
Unknown Ictaluridae	2	0.30%	0.32	0.03%	0.55	0.03%
Amidae (bowfin)						
Amia clava (bowfin)	2	0.30%	0.98	0.08%	3.29	0.17%
Catostomidae (sucker)						
Catostomus commersoni (common sucker)	1	0.15%	0.33	0.03%	1.51	0.08%
Acipenseridae (sturgeon)						
cf. *Acipenser fulvescens* (lake sturgeon)	1	0.15%	0.35	0.03%	1.58	0.08%
Lepisosteidae (gar)	2	0.30%	0.44	0.04%	1.72	0.09%
Unknown Osteichthyes	26	3.87%	0.42	0.03%	2.01	0.10%
TOTAL	**46**	**6.86%**	**3.96**	**0.32%**	**12.66**	**0.64%**
REPTILIA (Reptiles)						
Testudines (turtle)	15	2.24%	12.05	0.97%	25.91	1.31%
cf. *Apalone spinifera (eastern spiny softshell)*	1	0.15%	2.17	0.18%	6.69	0.34%
TOTAL	**16**	**2.38%**	**14.22**	**1.15%**	**32.59**	**1.65%**
ASSEMBLAGE TOTAL	**671**	**100.00%**	**1,239.12**	**100.00%**	**1981.3**	**100.00%**

the vertebrate assemblages are mostly larger species. As such, it appears that the subsistence strategy at Robinson Reserve targeted larger, locally available meat packages rather than a diverse suite of animals and a wide range of animal sizes. Just under 85% of the estimated biomass data within the above sample (Table 6.8), comes from terrestrial or upland animals (e.g., deer, *Cervidae*) (Figure 6.3).

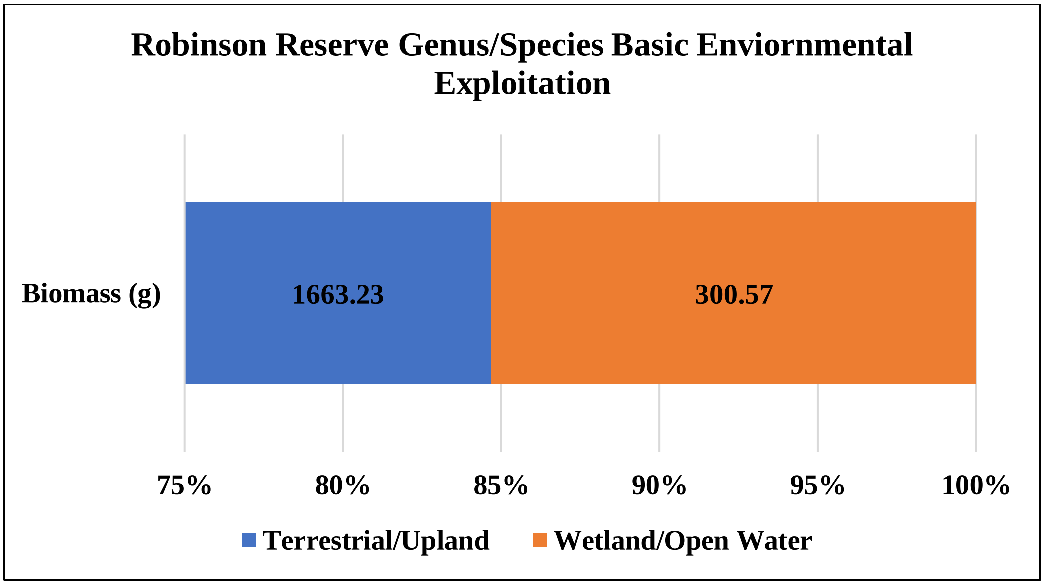

Figure 6.3. Robinson Reserve Faunal Exploitation Patterns by Environment

Deer Sub-Sample

Deer represent the largest animal protein resource at Robinson Reserve. A high proportion of lower limb elements are present within the assemblage (Table 6.9, Figure 6.4).

Table 6.9. Deer Body Parts from Robinson Reserve

Body Parts	NISP	Proportion	MNE	Proportion
Cranial	66	21.50%	38	18.36%
Axial	78	25.41%	39	18.84%
Upper Limb	69	22.48%	22	10.63%
Lower Limb	157	51.14%	108	52.17%
Total	307	100.00%	207	100.00%

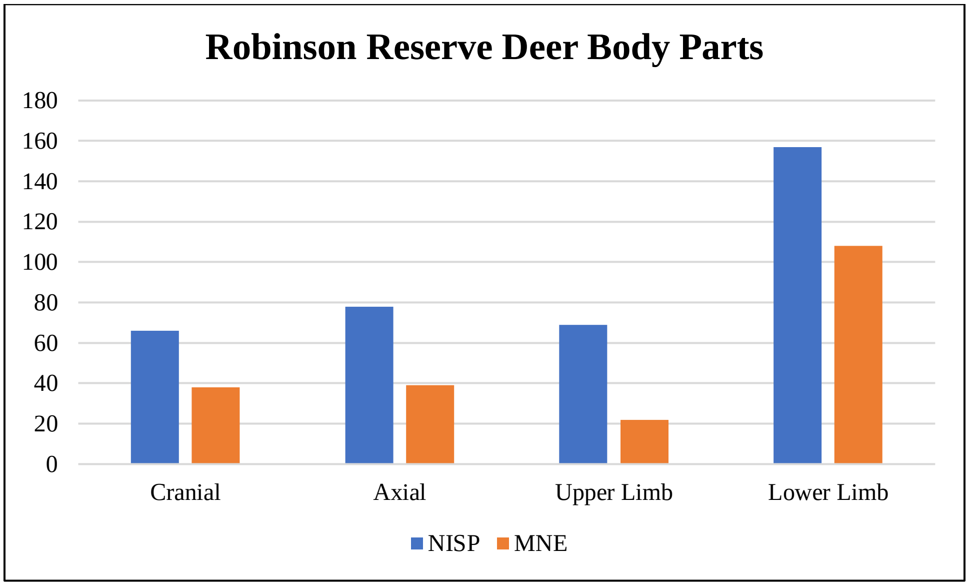

Figure 6.4. Robinson Reserve Deer Body Parts

This relatively low proportion of meatier body parts (e.g., axial and upper limb), and the similar proportion of cranial elements indicates the likelihood of local hunting and butchering (Binford 1978:74–75; Metcalf and Jones 1988:503–504; Lyman et al. 1992:539–540). Generally, cranial elements are not often brought back from longer distance field butchering (Binford 1978). However, lower limbs are often favored in local hunting for marrow and bone grease extraction.

Deer Mortality Profiles

The deer mortality pattern at Robinson Reserve shows a relatively high proportion of fawns and yearlings compared to mature animals (Table 6.10). Deer often mate in the autumn

(September to November) and fawns are often born in the spring (late May through June) (Dahlberg and Guettinger 1956; Verme 1965). The larger mortality seasons for the fawns and yearlings were during the summer. This does not mean that all activities at Robinson reserve necessarily occurred exclusively during this season, but it does show a specific targeting of smaller meat animals as well as a consistent seasonal line of evidence.

Table 6.10. Robinson Reserve Deer Mortality Profiles

Robinson Reserve		
Elements	**Age Range**	**NISP**
Lower milk 3rd premolar has erupted and shows wear	18-24	1
Lower 2nd permanent premolar erupted	30	1
Coronal Suture- half-fused	6	1
Sagittal Suture- unfused	6	1
Sagittal Suture- half fused	20	1
Sagittal Suture- fused	24	1
Humerus, Prox- fused	26-38	1
Humerus, Prox- unfused	<26	1
Femur, Dist- half fused	23-29	1
Lumbar Vertebra, unfused centrum epiphysis	<17	1
Thoracic Vertebra, unfused centrum epiphysis	<23	2
Sacrum, unfused superior epiphysis	<17	1
Radius, prox- half-fused	2-5	1

Robinson Reserve Summary

The faunal evidence at the Robinson Reserve site shows a pattern of local resource acquisition, with an emphasis on large mammal hunting. Deer are the dominant animal represented in the assemblages. The emphasis on large mammal resources, specifically *Cervidae*, with the very few aquatic animals utilized. The overall assemblage shows a pattern of targeting medium to larger animals. Deer remains show the potential of local hunting and butchering, with a majority of deer bones burned or calcined. Thus, marrow extraction may have been utilized to obtain a high amount of protein from the deer once acquired. Interestingly, there is a relatively high amount of fawns and yearlings identified at Robinson Reserve. As such, the assemblage may represent seasonal activities, possibly associated with the burial mounds.

Fox/Des Plaines Locality Summary

Washington Irving and Robinson Reserve have related but divergent vertebrate assemblages. Both respective assemblages show an emphasis on upland game, which is typical of Langford sites (e.g., Brown 1965; Emerson et al. 2010; Fowler 1952; Martin 1996; Pearce 2006; Pennaman 1999). The variety of fish species present and overall dietary contribution of fish at Washington Irving indicates a heavier reliance on wetland environments than at Robinson Reserve. The reliance on wetlands at Washington Irving, however, does not seem to be a simple matter of environmental availability. While Washington Irving is located immediately adjacent to a circa 4 ha. bottomland slough (Jeske 1990, 2000), the area surrounding the Robinson Reserve site is much drier, but the site itself is closer to the Des Plaines River than Washington Irving is to the Fox river (Jeske 1990; McTavish 2015). The Robinson Reserve faunal assemblage shows a lack of smaller fish species (e.g., minnow, shiner, bluegill) and a bias towards larger fish (e.g., catfish, gar). The peoples visiting, or occupying Robinson Reserve were targeting larger animals and fewer overall species than Washington Irving. This emphasis on higher protein yielding animals is an important distinction between the subsistence strategies at within the Fox/Des Plaines locality.

Overall, the Robinson Reserve and Washington Irving demonstrate different faunal signatures, which can be attributed to the difference in site function. The Robinson Reserve site appears to be a mortuary encampment. This revision of site function is based on a holistic incorporation of the archaeological material and the comparison with Washington Irving- a

Langford village site with excavated structures and paleobotantical evidence for year-round occupation (see Jeske 1990, 2000).

Previous research has established that there is significant variation in the mortuary program and patterns for Langford groups- much of the variation is seen regionally and between localities (Foley Winkler 2011). Some Langford villages do contain burials, burial mounds, or have scattered burials (Material Service Quarry, Zimmerman Grid-D, Gentleman's Farm), and some burial mound sites are independent of a village component (Wild Rose Mounds). Therefore, it is reasonable that Washington Irving is a village independent of burials, and Robison Reserve contains burial mounds but does not contain a significant village component. Robinson Reserve also does not contain any evidence of permanent structures. Therefore, the refuse is the result of a series of seasonal or short-term encampments, with more ephemeral shelters. As such, the refuse deposits are situated between the burial mounds, and therefore groups preformed the activities that produced this refuse between the burials on site.

Wild Rose Mounds is a comparable mound site within the locality. This site had very little fauna recovered and is also located right along the river (Foley Winkler 2011). The site occupants at Robinson Reserve were very aware of the presence of the burial mounds and the activities at the site had some type of connection to mortuary activities. We would expect these activities to leave a different pattern of refuse and landscape use than those at the year-round Washington Irving village site. As these are the only two sites systematically excavated in the locality that are devoid of palimpsest issues with previous Woodland groups (e.g., Cooke site), the expectations for such site types and their relationship with each other are necessary for the larger interpretation of the human-environmental relationship for the locality.

Robinson Reserve shows a dominance of two taxa- deer and muskrats. Whereas, the Washington Irving faunal assemblage shows more of an emphasis on fish, exploiting the nearby wetlands. This distinction can be summarized by the lower proportion of estimated biomass for mammals at Washington Irving is lower than Robinson Reserve (Irving= 85% of assemblage biomass; Reserve=99% of assemblage biomass). The Des Plaines River could have provided similar resources to the Robinson Reserve occupants. While there are some fish in the sample, they are very limited. People at Robinson Reserve appear to have targeted very specific aquatic resources- muskrat and turtle. Muskrat and turtle may have served the following purposes that fish may not have, especially in relation to mortuary-based activities:

1) Connection to underworld as often attributed to animals which come out of a primarily aquatic habitat
2) Body parts may have been used in rituals (e.g., turtle shell rattles, bowls, muskrat teeth, pelts)

Overall, the Washington Irving and Robinson Reserve faunal results show that there is are differences in Langford site faunal exploitation based on site function (i.e., mortuary sites, village sites). While both site faunal assemblages show a heavy reliance on deer and *Cervidae*, Washington Irving site occupants utilized aquatic resources and a wider variety of animals than Robinson Reserve. However, hunting and butchering strategies are similar. Deer body parts and mortality profiles indicate slightly different local hunting and processing strategies. At Washington Irving, there is evidence for age-specific hunting targeting prime-age and yearlings, while at Robinson Reserve there is an emphasis on yearlings and fawns. This difference in age selective hunting may be the result of site function, where younger animals were more important for mortuary or ritual activities rather than attempting to feed larger groups of families on a regular basis, as is expected at a village site.

Lake Koshkonong Oneota Results

Overall, the Lake Koshkonong Oneota faunal results indicate a distinction between each site. These differences in faunal signatures show a distinction between site function and the immediately local ecologies. The large sample sizes for these faunal assemblages represent a baseline for future subsistence research for this locality and can help frame expectations for Eastern Wisconsin.

Schmeling

A total of 16,922 vertebrate specimens, weighing 348.10 grams were recovered from the Schmeling site, of which 9,918 were identified to taxonomic class (Table 6.11). The high amount of unidentifiable vertebrate remains is due to the highly fragmented nature of the vertebrate assemblage. Within the identified vertebrate sample, fish and mammal were the predominate taxa within the assemblage, followed by bird and reptile. A total of 29 bivalves were recovered in the faunal assemblage. All valves were too worn or fragmented to be identified to genus or species.

While the faunal assemblage indicates a reliance on both mammal and fish, the reliance on fish is unsurprising since the site is located adjacent to Lake Koshkonong, where aquatic resources should have been readily available. When comparing an overall dietary emphasis within the site assemblage, the calculated biomass helps to illuminate the fish-mammal distinction, as well as the distinctions between mammal size categories (Table 6.11). Biomass data shows a slightly higher emphasis on mammal as a protein source over fish. The reversal of NISP and biomass relationship between fish and mammal is likely indicative of the species present within the assemblage (Table 6.12). There is a high proportion of deer within the mammal genus/species sub-sample. There are relatively few mammal species present, but there are a variety of fish species, which grow to a wide range of sizes.

Table 6.11. Schmeling Taxonomic Class Summary Data

Schmeling Taxonomic Class Summary Data				
Identification	**NSP**	**Proportion**	**Weight (g)**	**Proportion**
Identified	3,918	23.15%	865.69	67.95%
UNID	13,004	76.85%	408.37	32.05%
TOTAL	16,922	100.00%	1,274.06	100.00%
Taxonomic Class	**NISP**	**Proportion**	**Weight(g)**	**Proportion**
Fish	2,492	63.60%	323.81	37.40%
Bird	76	1.94%	76.5	8.84%
Mammal	1,309	33.41%	430.94	49.78%
Reptile	39	1.00%	33.53	3.87%
Amphibian	2	0.05%	0.91	0.11%
TOTAL	3,918	100.00%	865.69	100.00%
Undifferentiated Mammal Size Categories	**NISP**	**Proportion**	**Weight (g)**	**Proportion**
Class I Mammal	1	0.01%	4.48	1.83%
Class II Mammal	12	0.07%	12.05	4.91%
Class III Mammal	16	0.09%	18.79	7.66%
Class III/IV Mammal	4	0.02%	32.61	13.29%
Class IV Mammal	325	1.92%	113.74	46.34%
Class X Mammal	847	5.01%	63.77	25.98%

Table 6.12. Schmeling Biomass Summary Data

Schmeling Biomass Summary Data		
Taxa	**Biomass (g)**	**Proportion**
Mammal	680	55.28%
Birds	130	10.57%
Fish	350	28.46%
Reptile	70	5.69%

Species Summary Data: NISP, Bone Weight, Biomass

Overall, the emphasis of fish remains for the Schmeling faunal assemblage shows an emphasis on a variety of *Centrarchidae*, *Ictaluridae*, and *Percidae* (e.g., bass, sunfish, catfish, perch) (Table 6.13). The members of these fish families are found in a variety of habitats (e.g., vegetative, shallow, deep waters). The site's location on the northwest shores of Lake Koshkonong provided these resources to be obtained with relative ease. Edwards (2010) demonstrates wetlands and open water within 1 and 2km from the site. Therefore, the use of aquatic resources such as fish, waterfowl, and aquatic mammals (e.g., muskrat, otter, beaver) would have been readily available.

Of the mammal remains identified, the majority are identified as *cervidae* and white-tailed deer. While the majority of the protein at the site comes from mammal resources, fish and bird compose a relatively steady secondary resource. There are a variety of watershed resources present within the site assemblage. All bird species identified within the assemblage are waterfowl, with the exception of passenger pigeon. Additionally, river otter, beaver and muskrat were identified within the mammal sub-sample. Therefore, this faunal assemblage does not follow an assumed pattern of high mammal emphasis necessarily equating to hunting being the predominate form of protein acquisition. However, the question of local versus non-local hunting is an important line to investigate as a line of inquiry with regards to local vs. non-local resource acquisition overall.

Table 6.13. Schmeling Species Summary Data

Taxa	NISP	Proportion	Weight (g)	Proportion	Biomass (g)	Proportion
MAMMALIA (Mammals)						
Artiodactyla						
Cervidae	12	0.40%	23.4	4.38%	41.48	5.82%
Odocoileus virginianus (deer)	46	1.55%	61.03	11.43%	97.38	13.66%
Carnivora		0.00%		0.00%		0.00%
Procyonidae		0.00%		0.00%		0.00%
Procyon lotor (raccoon)	3	0.10%	3.05	0.57%	6.1	0.86%
Mustelidae (weasels)	1	0.03%	0.58	0.11%	1.37	0.19%
Lontra canadensis (river otter)	4	0.13%	3.16	0.59%	6.29	0.88%
Undifferentiated Carnivora	2	0.07%	1.07	0.20%	2.38	0.33%
Rodentia		0.00%		0.00%		0.00%
Castor canadensis (beaver)	3	0.10%	3.01	0.56%	6.44	0.90%
Ondatra zibethicus (muskrat)	8	0.27%	4.15	0.78%	8.62	1.21%
Sciuridae (squirrel, chipmunk)		0.00%		0.00%		0.00%
Sciurus (tree squirrels)	4	0.13%	0.41	0.08%	1.01	0.14%
Unknown Rodentia	3	0.10%	0.73	0.14%	1.68	0.24%
TOTAL	***86***	2.90%	***101***	18.84%	***172.75***	24.23%
AVES (birds)		0.00%		0.00%		0.00%
Anseriformes (waterfowl)	13	0.44%	8.32	1.56%	13.32	1.87%
Anatidae (goose, duck)	3	0.10%	4.06	0.76%	6.93	0.97%
Anas (dabbling ducks)	22	0.74%	26.41	4.95%	41.66	5.84%
Anas platyrhynchos (mallard)	16	0.54%	16.37	3.07%	26.86	3.77%
Rallidae (coots, rails, waterhens)		0.00%		0.00%		0.00%
Fulcra americana (coot)	3	0.10%	2.88	0.54%	5.07	0.71%
Columbiformes (pigeon, dove)		0.00%		0.00%		0.00%
Ectopistes migratorius (passenger pigeon)	4	0.13%	4.09	0.77%	7.72	1.08%
Unknown Aves	15	0.51%	14.37	2.69%	23.96	3.36%
TOTAL	***76***	2.56%	***76.5***	14.33%	***125.51***	17.60%

Taxa	NISP	Proportion	Weight (g)	Proportion	Biomass (g)	Proportion
OSTEICHTHYES (Fish)		0.00%		0.00%		0.00%
Perciformes (perch-like fishes)		0.00%		0.00%		0.00%
Centrarchidae (sunfish, lobina)	59	1.99%	33.14	6.21%	73.47	10.30%
Lepomis (common sunfish)	21	0.71%	12.25	2.29%	28.21	3.96%
Lepomis macrochiru (bluegill)	16	0.54%	9.06	1.70%	22.63	3.17%
Lepomis cyanellus (green sunfish)	6	0.20%	3.27	0.61%	8.73	1.22%
Micropterus (Bass)	22	0.74%	24.09	4.51%	55.21	7.74%
Micropterus salmoidae (largemouth bass)	18	0.61%	19.53	3.66%	44.55	6.25%
Ictaluridae (catfish)	37	1.25%	40.19	7.53%	57.61	8.08%
Ameiurus spp. (bullhead)	13	0.44%	11.55	2.16%	16.92	2.37%
Ameiurus nebulosus (brown bullhead)	12	0.40%	10.27	1.92%	15.5	2.17%
Ictalurus punctatus (channel catfish)	14	0.47%	16.33	3.06%	23.65	3.32%
Percidae (true perch)		0.00%		0.00%		0.00%
Perca flavescens (yellow perch)	16	0.54%	12.25	2.29%	0.01	0.00%
Sander vitreus (walleye)	7	0.24%	4.06	0.76%	0	0.00%
Unknown Osteichthyes	2,251	75.92%	127.82	23.94%	0.13	0.02%
TOTAL	***2,492***	84.05%	***324***	60.64%	***346.62***	48.61%
REPTILIA (Reptiles)		0.00%		0.00%		0.00%
Testudines (turtle)	29	0.98%	24.16	4.52%	42.1	5.90%
Chelydra serpentina (snapping turtle)	10	0.34%	9.37	1.75%	25.93	3.64%
TOTAL	***39***	1.32%	***33.53***	6.28%	68.03	9.54%
AMPHIBIA (amphibians)		0.00%		0.00%		0.00%
Anura (frogs, toads)	2	0.07%	0.02	0.00%		0.00%
TOTAL	***2***	0.07%	***0.02***	0.00%		0.00%
ASSEMBLAGE TOTAL	***2,965***	100.00%	***534***	100.00%	***713***	100.00%

Deer Body Parts

The deer body parts recovered from the Schmeling site show an emphasis on upper limbs (Table 6.14, Figure 6.5). The Schmeling deer body parts sub-sample indicates that there is approximately a 1:5 ratio of cranial elements to upper limbs. This ratio favors a higher proportion of upper limb elements. This pattern aligns with expectations for non-local butchering. In the case of Schmeling, this may indicate either non-local hunting or the transport of deer meat packages to the site from the nearby CBHC and KCV villages.

Table 6.14. Schmeling Deer Body Parts

Body Parts	NISP	Proportion	MNE	Proportion
Cranial	3	6.52%	2	10.00%
Axial	4	8.70%	2	10.00%
Upper Limb	28	60.87%	10	50.00%
Lower Limb	11	23.91%	6	30.00%
Total	46	100.00%	20	100.00%

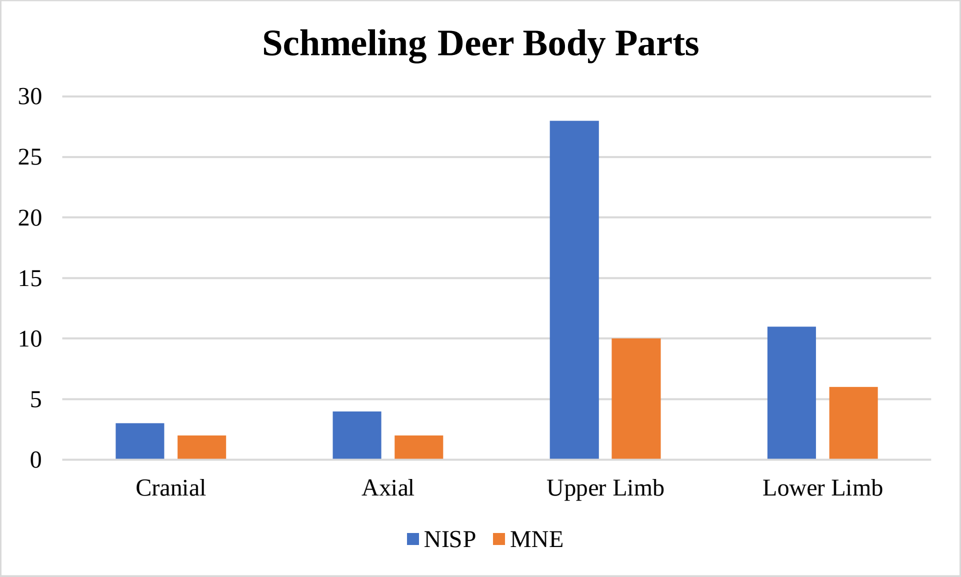

Figure 6.5. Schmeling Deer Body Parts

Deer Mortality Profiles

Like Robinson Reserve, deer elements able to be assigned an age range at Schmeling represent mostly fawns and yearlings rather than an emphasis on mature deer (Table 6.15). The larger mortality seasons for the fawns and yearlings occur in the summer. This pattern does not mean that all activities at Schmeling necessarily occurred exclusively during this season, but it does show a specific targeting of smaller meat animals as well as a consistent seasonal line of evidence. As such, the deer mortality profile at Schmeling shows a pattern different from one expected as a typical village site- where either mature deer it is expected that year-round village occupants would be targeted, or a variety of age ranges would be represented. This age-targeted pattern is different from the expected age-targeted pattern, where groups would target prime-age adult deer.

Table 6.15. Schmeling Deer Mortality Profile

Deer Mortality Profile		
Elements	**Age Range**	**NISP**
Humerus, Prox- fused	26-38	1
Humerus, Prox- unfused	<26	1
Femur, Dist- half fused	23-29	1
Lumbar Vertebra, unfused centrum epiphysis	<17	1
Thoracic Vertebra, unfused centrum epiphysis	<23	2

Schmeling Summary

The Schmeling site shows a shared emphasis on aquatic resources and white-tailed deer. The white-tailed deer body parts show a pattern indicative of non-local hunting and processing. Further, the deer sample indicates an emphasis on yearlings, which is unexpected for an age-targeted hunting strategy. Given that this faunal assemblage is associated with the mortuary complex at the site, and is classified as the area within the locality with a formal cemetery (Foley Winkler 2004, 2011), these differences from a expected patterns are likely the result of site function. While the faunal assemblage does not reflect animals interred within the burial contexts, there are no structures in which to associate these faunal remains. Therefore, the fauna may reflect mortuary feasts, offerings, short-term occupations surrounding the death of individuals or meals eaten during ancestor veneration rites.

The intact midden contexts analyzed were within a 10-20-meter proximity of burials, a respectful distance for trash disposal near a formal cemetery, especially if more interments were anticipated or the groups used the cemetery as a territorial marker (see Arnold 2008; Chapman 1995). Therefore, if Schmeling is continued to be classified as a village site, without evidence of structures, alternatively this particular area of the site possibly held a different function than a main habitation area.

Crescent Bay Hunt Club

A total of 50,652 vertebrate specimens, weighing 63,078.43 grams were recovered from the 13 features from the Crescent Bay Hunt Club site (Table 6.16). A total of 10,111 invertebrate specimens were identified and recorded (Table 6.17). Of the invertebrate sample, 9,750 were bivalves, and 328 valves were identified to species. This faunal assemblage is robust, and therefore a good representation of the human-animal relationships that occurred at the site. Since this is the largest dataset for eastern Wisconsin Oneota sites, the results can help to model expectations for eastern Oneota sites in Wisconsin.

Table 6.16. CBHC Class Summary Data

CBHC NSP and NISP Proportions

Identification	**NSP**	**Proportion**	**Weight (g)**	**Proportion**
Identified	39,428	77.84%	39,428	84.83%
UNID	11,224	22.16%	7,053.18	15.17%
TOTAL	50,652	100.00%	46,481	100.00%
Taxonomic Class	**NISP**	**Proportion**	**Weight (g)**	**Proportion**
Fish	12,379	31.40%	8,043	14.36%
Bird	1,203	3.05%	989.07	1.77%
Mammal	24,873	63.08%	45,992.71	82.09%
Reptile	952	2.41%	982.16	1.75%
Amphibian	21	0.05%	18.04	0.03%
TOTAL	39,428	100.00%	56,025	100.00%

Table 6.17. CBHC Bivalve Species

Species Present		Abundance				Preferred Habitats				
Common Name	**Scientific Name**	**NISP**	**Proportion**	**MNI**	**Proportion**	**Lg River**	**Med River**	**Sm River**	**Lake**	**Creek**
Butterfly	*Ellipsaria lineolata*	3	0.91%	2	0.94%	■	■			
Deertoe	*Truncilla truncata*	4	1.22%	3	1.41%	■	■		■	
Giant Floater	*Pyganodon grandis*	1	0.30%	1	0.47%			■	■	■
Creek Heelsplitter	*Lasmigona compressa*	12	3.66%	7	3.29%		■	■		■
Plain Pocketbook	*Lampsilis cardium*	28	8.54%	18	8.45%	■	■	■	■	■
Fat Mucket	*Lampsilis siliquoidea*	47	14.33%	30	14.08%		■		■	
Higgens' Eye	*Lampsilis higginsii*	8	2.44%	6	2.82%		■		■	
Monkeyface	*Quadrula metanevra*	1	0.30%	1	0.47%	■	■	■		
Paper Pondshell	*Utterbackia imbecillis*	2	0.61%	1	0.47%				■	■
Pink Heelsplitter	*Potamilus alatus*	4	1.22%	3	1.41%	■	■	■	■	■
Purple Wartyback	*Cyclonaias tuberculata*	7	2.13%	5	2.35%	■	■	■		
Slippershell	*Alasmidonta viridis*	2	0.61%	1	0.47%			■		■
Slough Sandshell	*Lampsilis teres*	5	1.52%	2	0.94%	■	■	■	■	■
Spike	*Elliptio dilatata*	147	44.82%	97	45.54%	■	■	■		
Three Ridge	*Amblema plicata*	14	4.27%	8	3.76%	■	■	■		
Winged Mapleleaf	*Quadrula fragosa*	2	0.61%	2	0.94%	■	■	■		
Yellow Sandshell	*Lampsilis teres*	41	12.50%	26	12.21%	■	■	■	■	■
	TOTAL	**328**	**100.00%**	**213**	**100.00%**					

Given that CBHC is located adjacent to Lake Koshkonong and within a very close proximity to Schmeling, it is unsurprising that there is a relatively high emphasis on fish within the vertebrate assemblage. Since shellfish were used as a ceramic tempering agent, the bivalves collected and deposited at CBHC may be the result of both subsistence and technological resource acquisition. When comparing an overall dietary emphasis within the site assemblage, the calculated biomass shows that within the vertebrate resources, there is a clearer distinction between fish and mammal resources (Table 6.18). Further, the biomass data shows the high emphasis on large mammals (Class IV) within the undifferentiated mammal remains.

Table 6.18. CBHC Vertebrate Taxonomic Class Summary Data

Crescent Bay Hunt Club		
Taxa	**Biomass (g)**	**Proportion**
Mammal	52,280	78.59%
Birds	1,460	2.20%
Fish	11,570	17.39%
Reptile	1,210	1.82%
Undifferentiated Mammal Sizes	**Biomass (g)**	**Proportion**
Class I	114.94	0.34%
Class II	760.76	2.26%
Class III	1,159.88	3.45%
Class III/IV	430.3	1.28%
Class IV	12,597.89	37.47%
Class X	18,555.03	55.19%

Species Summary Data: NISP, Weights, Biomass

Most mammals represented in the CBHC assemblage sample are *cervidae*, many of which are white-tailed deer (Tables 6.19). Undifferentiated large mammal fragments and un-sized mammals could also represent members of the family *Cervidae*. Medium mammals at the site include those found typically alongside field edges, forests, and river or lakeshores (e.g., raccoon, rabbits, beaver and muskrat). Such animals provided pelts and a supplementary protein resource. Raccoon, beaver and muskrat could all have been trapped along the shores of Lake Koshkonong or in adjacent wetlands. Rabbits, raccoon and deer would have also been attracted to field edge areas or found near forests or oak savannas. As such, these mammals may have been trapped or hunted during other daily pursuits (e.g., agriculture, collecting shellfish, fishing, gathering wild rice). The presence of domestic dog at the site is representative of a dog burial found at the base of a refuse pit.

Table 6.19. CBHC Species Summary Data

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass (g)	Proportion
MAMMALIA (Mammals)						
Artiodactyla	26	0.20%	48.04	0.25%	80.62	0.29%
Cervidae	879	6.80%	2,804.91	14.75%	3660.05	13.37%
Bison bison (bison)	3	0.02%	39.1	0.21%	64.57	0.24%
cf. Bison bison (bison)	1	0.01%	6.75	0.04%	12.46	0.05%
Odocoileus virginianus (deer)	2,786	21.55%	5,981.49	31.46%	7,284.46	26.60%
cf. Odocoileus virginianus	687	5.31%	935.37	4.92%	1,321.60	4.83%
Cervus elaphus	13	0.10%	66.48	0.35%	115.46	0.42%
cf. Cervus elaphus	8	0.06%	39.11	0.21%	67.48	0.25%
Carnivora	86	0.67%	76.39	0.40%	133.76	0.49%
Ursus						
Ursus americanus (American black bear)	6	0.05%	14.08	0.07%	25.42	0.09%
Canidae (dog, wolf)	88	0.68%	138.03	0.73%	230.38	0.84%
Canis lupus familiaris (domestic dog)	46	0.36%	92.11	0.48%	130.95	0.48%
Vulpes						
Vulpes vulpes (red fox)	47	0.36%	67.18	0.35%	110.49	0.40%
Procyonidae						
Procyon lotor (raccoon)	524	4.05%	829.04	4.36%	1,206.03	4.40%
Mustelidae (mustelids)	24	0.19%	32.16	0.17%	56.07	0.20%
Lontra canadensis (river otter)	26	0.20%	20.71	0.11%	36.9	0.13%
Martes pennanti (fisher)	3	0.02%	3.06	0.02%	6.11	0.02%
Neovison vison (American mink)	11	0.09%	5.19	0.03%	9.84	0.04%
Taxidea taxus (American badger)	48	0.37%	61.17	0.32%	105.36	0.38%
Mephitidae (skunks)						
Mephitis (striped skunk)	4	0.03%	3.62	0.02%	7.11	0.03%
Felinae (felines)						
Lynx (bobcats, lynx)	6	0.05%	6.77	0.04%	13.89	0.05%
Lynx rufus (bobcat)	4	0.03%	2.19	0.01%	4.52	0.02%
Didelphimorphia						

Taxa	**NISP**	**Proportion**	**Weight (g.)**	**Proportion**	**Biomass (g)**	**Proportion**
Didelphidae (opossums)						
Didelphis virginianus (North American opossum)	2	0.02%	1.98	0.01%	4.13	0.02%
Lagomorpha (hares, rabbits)						
Leporidae (cottontails)	12	0.09%	13.41	0.07%	26.17	0.10%
Sylvilagus floridanus (eastern cottontail)	363	2.81%	432.91	2.28%	673.84	2.46%
Rodentia	482	3.73%	482.95	2.54%	753.2	2.75%
Castoridae						
Castor (beavers)						
Castor canadensis (American beaver)	383	2.96%	513.85	2.70%	749.01	2.74%
Cricetidae						
Ondatra (muskrats)						
Ondatra zibethicus (common muskrat)	598	4.62%	627.62	3.30%	922.69	3.37%
Sciuridae (squirrel, chipmunk)	212	1.64%	182.16	0.96%	309.14	1.13%
Sciurus (tree squirrels)	269	2.08%	250.73	1.32%	405.7	1.48%
Sciurus carolinensis (gray squirrel)	18	0.14%	15.42	0.08%	29.71	0.11%
Tamiasciurus hudsonicus (red squirrel)	24	0.19%	19.07	0.10%	36.96	0.13%
Tamias	23	0.18%	12.46	0.07%	24.53	0.09%
Tamias striatu (eastern chipmunk)	36	0.28%	21.73	0.11%	43.77	0.16%
TOTAL	**7,748**	**59.92%**	**13,847.24**	**72.82%**	**18662.38**	**68.15%**
AVES (Birds)						
Anseriformes (duck, geese, swan, waterfowl)	18	0.14%	12.03	0.06%	20.26	0.07%
Anatidae (duck, geese, swan)	34	0.26%	49.71	0.26%	76.77	0.28%
Anas (dabbling ducks)	21	0.16%	35.19	0.19%	58.17	0.21%
Anas platyrhynchos (mallard)	214	1.66%	129.07	0.68%	186.98	0.68%
Anas crecca (green-winged teal)	3	0.02%	2.74	0.01%	4.85	0.02%
Lophodytes (hooded mergansers)						
Lophodytes cucullatus (hooded merganser)	1	0.01%	0.59	0.00%	1.2	0.00%
Aix (wood ducks)						
Aix sponsa (wood duck)	96	0.74%	84.05	0.44%	123.7	0.45%
Aythya (diving ducks)	2	0.02%	1.26	0.01%	2.39	0.01%

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass (g)	Proportion
Aythya affinis (lesser scaup)	128	0.99%	71.05	0.37%	106.67	0.39%
Branta (brent geese)						
Branta canadensis (Canada goose)	98	0.76%	98.92	0.52%	137.19	0.50%
Gaviiformes (loons, huarts)						
Gaviidae (loons, divers)	2	0.02%	1.58	0.01%	2.94	0.01%
Gavia immer (common loon)	7	0.05%	6.55	0.03%	11.4	0.04%
Galliformes (fowls)						
Phaisanidae (partridge, turkey, grouse)						
Phasianinae (pheasants)						
Phasianus colchicus (ring necked pheasant)	13	0.10%	12.74	0.07%	22.37	0.08%
Bonasa (ruffled grouse)						
Bonasa umbellus (ruffled grouse)	2	0.02%	0.85	0.00%	1.67	0.01%
Meleagris (turkeys)						
Meleagris gallopavo (wild turkey)	6	0.05%	9.43	0.05%	14.92	0.05%
Columbiformes (doves, pigeons)						
Columbidae (doves, pigeons)	36	0.28%	19.72	0.10%	32.68	0.12%
Ectopistes (passenger pigeons)						
Ectopistes migratorius (passenger pigeon)	18	0.14%	20.19	0.11%	33.64	0.12%
Passeriformes (perching birds)	31	0.24%	18.72	0.10%	27.85	0.10%
Corvidae (crows, jays, magpies)	4	0.03%	1.54	0.01%	2.87	0.01%
Corvus (crows)						
Corvus brachyrhyncho (American crow)	6	0.05%	5.19	0.03%	9.53	0.03%
Cyanoccita (blue jays)						
Cyanocitta cristata (blue jay)	2	0.02%	0.63	0.00%	1.27	0.00%
Turidae						
Turdus (robins)						
Turdus migratorius (American robin)	3	0.02%	0.66	0.00%	1.33	0.00%
Emberizidae (finches, sparrows)	1	0.01%	0.08	0.00%	0.19	0.00%
Melospiza (song sparrows)						

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass (g)	Proportion
Melospiza melodia (song sparrow)	1	0.01%	0.03	0.00%	0.08	0.00%
Fringillidae (grosbecs, finches)	1	0.01%	0.14	0.00%	0.32	0.00%
Spinus						
Spinus tristis (American goldfinch)	1	0.01%	0.12	0.00%	0.28	0.00%
Mimidae (mockingbirds, thrashers)	1	0.01%	0.88	0.00%	1.72	0.01%
Mimus (mockingbirds)						
Mimus polyglottos (northern mockingbird)	1	0.01%	1.06	0.01%	2.04	0.01%
Hirundinidae (swallows)	1	0.01%	0.83	0.00%	1.63	0.01%
Progne						
Progne subis (purple martin)	1	0.01%	0.99	0.01%	1.92	0.01%
Icteridae (blackbirds, oreols)	2	0.02%	1.43	0.01%	2.68	0.01%
Agelaius (red-winged blackbirds)						
Agelaius phoeniceus (red-winged blackbird)	2	0.02%	1.68	0.01%	3.11	0.01%
Suliformes (cormorants)						
Phalacrocoracidae (cormorants, shags)						
Phalacrocorax (cormorant)						
Phalacrocorax auritus (double-crested cormorant)	8	0.06%	13.26	0.07%	21.83	0.08%
Pelecaniformes (pelicans, herons)						
Ardeinae (herons, egrets)						
Ardea (great herons)						
Ardea herodias (great blue heron)	1	0.01%	3.06	0.02%	5.36	0.02%
Accipitriformes (hawks, eagles)	1	0.01%	1.14	0.01%	2.18	0.01%
Accipitridae (hawk, eagle)	43	0.33%	68.11	0.36%	90.21	0.33%
Accipiter (bird hawks)	1	0.01%	1.16	0.01%	2.22	0.01%
Accipiter cooperii (Cooper's hawk)	2	0.02%	3.42	0.02%	5.93	0.02%
Buteo (buteonine hawks)						
Buteo jamaicensis (red-tailed hawk)	2	0.02%	2.05	0.01%	3.72	0.01%
Stringiformes (owls)	14	0.11%	11.42	0.06%	20.34	0.07%
Stringidae (typical owls)						

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass (g)	Proportion
Bubo (horned owls)						
Bubo virinianus (great horned owl)	6	0.05%	6.64	0.03%	10.84	0.04%
TOTAL	**835**	**6.46%**	**699.91**	**3.68%**	**1,057.25**	**3.86%**
Teleostei (Boney Fish)						
Perciformes (perch-like fishes)	12	0.09%	9.11	0.05%	24.53	0.09%
Centrarchidae (sunfish, lobina)	609	4.71%	618.42	3.25%	857.55	3.13%
Lepomis (common sunfish)	62	0.48%	55.74	0.29%	106.92	0.39%
Lepomis gibbosus (pumpkinseed)	143	1.11%	168.41	0.89%	308.06	1.12%
Lepomis macrochiru (bluegill)	112	0.87%	86.72	0.46%	178.75	0.65%
Lepomis cyanellu (green sunfish)	131	1.01%	103.42	0.54%	211.17	0.77%
Ambloplites (rock basses)						
Ambloplites rupestri (rock bass)	101	0.78%	84.73	0.45%	186.83	0.68%
Micropterus (bass)	226	1.75%	204.83	1.08%	368.77	1.35%
Micropterus salmoidae (largemouth bass)	285	2.20%	334.72	1.76%	599.71	2.19%
Micropterus dolomieu (smallmouth bass)	392	3.03%	409.11	2.15%	679.31	2.48%
Pomoxis (crappies)	14	0.11%	13.81	0.07%	33.11	0.12%
Pomoxis nigromaculatus (black crappie)	164	1.27%	155.92	0.82%	302.11	1.10%
Percidae (true perches)	2	0.02%	0.93	0.00%	3.15	0.01%
Perca flavescens (yellow perch)	103	0.80%	98.21	0.52%	200.92	0.73%
Sander viteus (walleye)	79	0.61%	76.38	0.40%	155.57	0.57%
Sciaenidae (croakers, drum)	28	0.22%	24.65	0.13%	52.54	0.19%
Aplodinotus (river drum, freshwater drum)						
Aplodinotus grunniens (freshwater drum)	81	0.63%	109.85	0.58%	221.96	0.81%
Lepisosteiformes						
Lepisosteidae (gar pikes, gar)						
Lepisosteus (slender gar)						
Lepisosteus osseus (longnose gar)	2	0.02%	1.87	0.01%	7.76	0.03%
Siluriformes (silures, catfish)						
Ictaluridae (catfishes)	368	2.85%	519.97	2.73%	694.37	2.54%
Ameriurus (bullheads)	37	0.29%	54.62	0.29%	77.76	0.28%

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass (g)	Proportion
Ameiurus nebulosus (brown bullhead)	58	0.45%	91.7	0.48%	131.24	0.48%
Ictalurus (channel catfish, forktail catfish)	22	0.17%	36.74	0.19%	52.97	0.19%
Ictalurus punctatus (channel catfish)	261	2.02%	339.15	1.78%	452.76	1.65%
Cypriniformes (minnow, sucker)	144	1.11%	92.17	0.48%	180.56	0.66%
Cyprinidae (shiner)	112	0.87%	73.22	0.39%	156.71	0.57%
Catostomidae (suckers, catostomes)	102	0.79%	54.62	0.29%	130.64	0.48%
Ictiobus (buffalo suckers)						
Ictiobus cyprinellu (bigmouth buffalo)	4	0.03%	3.16	0.02%	9	0.03%
Moxostoma (redhorse suckers)	24	0.19%	22.84	0.12%	63.51	0.23%
Catostomus (common sucker)	219	1.69%	184.7	0.97%	366.43	1.34%
Catostomus commersonii (white sucker)	234	1.81%	194.77	1.02%	368.11	1.34%
Esociformes (mudminnows, pikes)						
Esocidae (pickerels, pikes, brochets)						
Esox (pikes)	64	0.49%	66.07	0.35%	130.94	0.48%
Esox lucius (northern pike)	39	0.30%	41.14	0.22%	95.25	0.35%
Esox masquinongy (muskellunge)	2	0.02%	4.11	0.02%	11.08	0.04%
TOTAL	**4,236**	**32.76%**	**4,336**	**22.80%**	**7,420**	**27.10%**
REPTILIA (Reptiles)						
Testudines (tortues, turtles, terrapins, tortoises)						
Emydidae (pond turtles, terrapins)	12	0.09%	13.21	0.07%	36.87	0.13%
Chrysemys pict (painted turtles)	1	0.01%	2.45	0.01%	9.08	0.03%
Graptemys (map turtles)						
Graptemys geographica (northern map turtle)	16	0.12%	22.37	0.12%	56.02	0.20%
Terrapene (box turtles)						
Terrapene ornat (western box turtle)	12	0.09%	14.56	0.08%	29.98	0.11%

Taxa	**NISP**	**Proportion**	**Weight (g.)**	**Proportion**	**Biomass (g)**	**Proportion**
Chelydra serpentina (snapping Turtle)	49	0.38%	62.14	0.33%	113.74	0.42%
TOTAL	90	0.70%	114.73	0.60%	245.69	0.90%
Amphibia (Amphibians)						
Anura (frogs, toads)	11	0.09%	6.78	0.04%		
Ranidae (riparian frogs)						
Lithobates catesbeianu (American bullfrog)	10	0.08%	11.26	0.06%		
TOTAL	21	0.16%	18.04	0.09%		
ASSEMBLAGE TOTAL	**12,930**	**100%**	**19,016**	**100%**	**27,385**	**100%**

Other *Carnivora* and *Canidae* are represented at the site, may correspond with other dogs at the site- but were unable to be definitively classified as domestic dog. These specimens may represent wolves, coyote, foxes, or bobcats. Additionally, there is a sizeable proportion of members of the family *Sciuridae*- squirrels and chipmunk. These animals may have hunted as pest maintenance from storage areas, smaller game hunting during times of environmental or socio-political stress, or for hunting practice among children. Undifferentiated un-sized mammal fragments may represent any of these animals, but may also be associated with marrow extraction, crushing for bone grease, or general processing of animal carcasses.

The bird sample at CBHC shows an emphasis is on waterfowl and raptors. Waterfowl would seasonally nest along the wetlands and banks of Lake Koshkonong, making them semi-reliable protein resources during the spring and summer months. Waterfowl are often found at Oneota sites and may have been valued for their eggs and feathers. Eggs could have provided another source of nutrients, while feathers may have served multiple purposes (e.g., fletching, personal adornment, rituals). Birds traditionally serve a dual purpose for subsistence and their cosmological or symbolic association with sky or upper world (Hall 2002; Overstreet 1997). The relatively higher proportion of raptors specifically eagle at the site corresponds with a partial eagle burial uncovered in a refuse pit.

Much of the fish at CBHC are members of the family *Centrarchidae*- varieties of bass and sunfish. A variety of catfish, suckers, pike and muskellunges (Muskie) were recovered. The variety of fish types and general sizes show a preference for a diversified diet and capture plan. The site inhabitants were probably fishing with a variety of techniques to target bottom, shallow water, deep water, and vegetative water dwellers. Fishing for bottom-dwelling fish could have been conducted using hook-and-line. Additionally, net weirs would have provided a delayed capture technique, allowing for the site inhabitants to gather wild rice or shellfish nearby and then check net weirs or set lines before and afterward these pursuits.

Of the reptiles most of the turtles would have easily been found alongside watersheds, sunning themselves on rocks or logs, but they also could have been netted. In addition, box turtles are often found along forest edges.

Deer Body Parts

The deer body parts represented in the CBHC assemblage mirrors the expectations for a local hunting strategy, with a 91:109 ratio of cranial elements to upper limbs (Table 6.20, Figure 6.6). This relatively high proportion of cranial elements would not be expected to have been transported back to the site across long distances. This local hunting strategy is different from the Schmeling site, where it is likely non-local hunting or processing.

Table 6.20. CBHC Deer Body Parts

Body Parts	**NISP**	**Proportion**	**MNE**	**Proportion**
Cranial	423	12.18%	182	16.90%
Axial	804	23.15%	296	27.48%
Upper Limb	829	23.87%	218	20.24%
Lower Limb	1417	40.80%	381	35.38%
Total	**3473**	**100%**	**1077**	**100%**

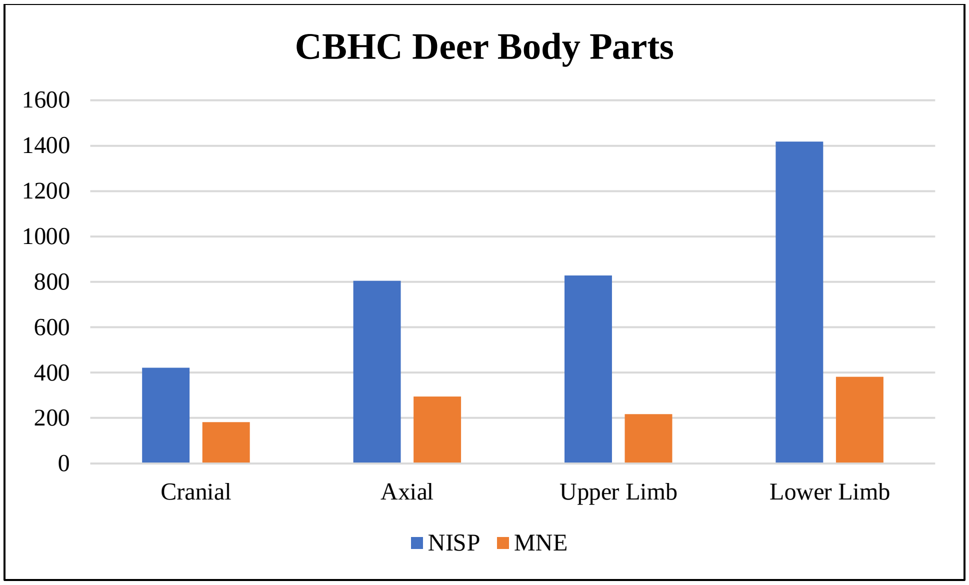

Figure 6.6. CBHC Deer Body Parts

Local hunting and processing of deer may indicate a preference for hunting near agricultural fields or the use of forest-edge habitats. Local hunting in agricultural fields may have been opportunistic, while hunting groups leaving the site and returning, and exploiting forest and forest-edge areas would require a coordinated effort. Overall, the faunal assemblage shows a diversified diet and animal exploitation. Therefore, it is possible that deer hunting was local to allow for more time and labor expenditures on agricultural pursuits and the time needed for exploiting other local resources apart from coordinated forest hunting events (e.g., mussel shell gathering, wild rice and Chenopodium harvest, fishing).

Deer Mortality Profiles

At CBHC, the deer elements able to be aged represent both mature and juvenile deer (Table 6.21). This pattern indicates a non-age selective hunting strategy. It appears the site occupants were targeting adult deer but did not exclude yearlings and fawns. Fawns and yearlings were not conserved for future hunting, when they would have provided a larger caloric return. The site occupants were targeting deer without regards for future hunting or sustaining their local deer populations. The taking of fawns may be the result of a local resource depression, a bottle-necking or restriction of resource acquisition areas due to inter-group conflict, or both. Further, the capture of both mature and juvenile deer means that hunting was a year-round practice and not restricted solely to autumn- when deer are at their largest.

Table 6.21. CBHC Deer Mortality Profiles

Crescent Bay Hunt Club		
Elements	**Age Range**	**NISP**
Lower milk 3rd premolar has erupted and shows wear	18-24	4
Lower 2nd permanent premolar erupted	30	5
Only five erupted teeth	6	3
Coronal Suture- half-fused	6	2
Sagittal Suture- unfused	6	2
Sagittal Suture- half fused	20	3
Sagittal Suture- fused	24	4
Humerus, Prox- fused	26-38	2
Humerus, Prox- unfused	<26	6
Humerus, Dist- unfused	13-18	4
Femur, Dist- unfused	23-29	2
Femur, Dist- half fused	29-47	2
Lumbar Vertebra, unfused centrum epiphysis	<17	13
Thoracic Vertebra, unfused centrum epiphysis	<23	11
Sacrum, unfused superior epiphysis	<17	2
Radius, Prox- half-fused	2-5	3
Metapodial, Prox-half-fused	1-4	16

Crescent Bay Hunt Club Summary

The Crescent Bay Hunt Club faunal assemblage shows evidence of a subsistence strategy that reflects the immediate vicinity of both Lake Koshkonong and oak savannas. The variety of fish, bird, and mammal species exploited indicates a varied daily subsistence. Deer were significant to the diet, and were likely hunted locally, with an emphasis on yearlings and prime-age deer. These animals may have been hunted along field edges as a combination of crop protection and protein acquisition.

Koshkonong Creek Village

A total of 54,148 vertebrate specimens, weighing 80,918.84 grams were recovered from the Koshkonong Creek Village site, of which 44,119 were identifiable (Table 6.22). Over 80% of the total vertebrate specimens in the KCV faunal sample were able to be identified to taxonomic class. Mammal and fish are the most represented species within the identified sub-sample, with mammals comprising 61% NISP. Proportionally, the NISP and bone weight values for bird, reptile and amphibian are very low. Within the mammal sub-sample, those specimens not able to be identified to genus or species were assigned a size classification whenever possible. Of these undifferentiated mammal bone fragments, the majority are either large mammal or were unable to be assigned a size classification. The large mammal fragments may represent species such as white-tailed deer, elk and bear.

Table 6.22. KCV Site Summary Data

KCV Taxonomic Class Summary Data

Identification	**NSP**	**Proportion**	**Weight (g)**	**Proportion**
Identified	44,119	81.48%	74,875.24	92.53%
UNID	10,029	18.52%	6,043.86	7.47%
TOTAL	54,148	100.00%	80,919.10	100.00%

Taxonomic Class	**NISP**	**Proportion**	**Weight (g)**	**Proportion**
Fish	14,903	33.78%	8,414	11.24%
Bird	1,336	3.03%	629.37	0.84%
Mammal	26,983	61.16%	64,921.18	86.71%
Reptile	875	1.98%	901.28	1.20%
Amphibian	22	0.05%	9.41	0.01%
TOTAL	44,119	100.00%	74,875.24	100.00%

Mammal Size Categories	**NISP**	**Proportion**	**Weight (g)**	**Proportion**
Class I Mammal	104	0.73%	54.16	0.17%
Class II Mammal	246	1.72%	342.05	1.08%
Class III Mammal	558	3.90%	504.71	1.59%
Class III/IV Mammal	192	1.34%	228.73	0.72%
Class IV Mammal	7,834	54.72%	24,894.03	78.46%
Class X Mammal	5,382	37.59%	5,703.14	17.98%
TOTAL	14316	100.00%	31726.82	100.00%

Overall, the KCV invertebrate assemblage contains 369 bivalve specimens which were able to be identified to species (Table 6.23). The sample total MNI value is 227 animals. The KCV residents favored Spike, Fat Mucket, Yellow Sandshell and Three Ridge. These mussels are all local to the Lake Koshkonong locality and are often recovered from Oneota sites within Wisconsin (see Theler 1991). These animals may have been collected along Koshkonong Creek or along Lake Koshkonong. Shellfish were a valuable raw material resource for ceramic tempering, so these animals served a subsistence and technological purpose.

Table 6.23. KCV Invertebrate Summary Data

Species Present		Abundance				Preferred Habitats				
Common Name	**Scientific Name**	**NISP**	**Proportion**	**MNI**	**Proportion**	**Lg River**	**Med River**	**Sm River**	**Lake**	**Creek**
Butterfly	*Ellipsaria lineolata*	2	0.54%	2	0.88%	■	■			
Deertoe	*Truncilla truncata*	1	0.27%	1	0.44%	■	■		■	
Creek Heelsplitter	*Lasmigona compressa*	20	5.42%	14	6.17%		■	■		■
Plain Pocketbook	*Lampsilis cardium*	9	2.44%	5	2.20%	■	■	■	■	■
Fat Mucket	*Lampsilis siliquoidea*	74	20.05%	51	22.47%		■		■	
Higgens' Eye	*Lampsilis higginsii*	2	0.54%	2	0.88%		■		■	
Pink Heelsplitter	*Potamilus alatus*	1	0.27%	1	0.44%	■	■	■	■	■
Purple Wartyback	*Cyclonaias tuberculata*	2	0.54%	2	0.88%	■	■	■		
Slough Sandshell	*Lampsilis teres*	2	0.54%	1	0.44%	■	■	■	■	■
Spike	*Elliptio dilatata*	157	42.55%	97	42.73%	■	■	■	■	
Three Ridge	*Amblema plicata*	40	10.84%	22	9.69%	■	■	■	■	
Yellow Sandshell	*Lampsilis teres*	59	15.99%	29	12.78%	■	■	■	■	■
TOTAL		**369**	**100.00%**	**227**	**100.00%**					

Overall, the KCV biomass calculations show an emphasis on mammal protein within the diet. Further, of the undifferentiated mammal remains, the majority of the protein comes from large mammals (Table 6.24). This may indicate a higher emphasis on hunting and trapping over fishing as part of the daily subsistence economics.

Table 6.24 KCV Taxonomic Class Biomass

Koshkonong Creek Village		
Taxa	**Biomass (g)**	**Proportion**
Mammal	80640	88.68%
Birds	860	0.95%
Fish	9270	10.19%
Reptile	160	0.18%
Undifferentiated Mammal Sizes		
Class I	67.40	0.17%
Class II	425.66	1.08%
Class III	628.08	1.59%
Class III/IV	284.64	0.72%
Class IV	30979.24	78.46%
Class X	7097.24	17.98%

Species NISP and Weights and Biomass

Of the sample of vertebrate remains which were identified, approximately 28% NISP were identified as white-tailed deer. These deer bones were calculated to estimate approximately 56% of the total biomass represented by the genus/species sample. This means that white-tailed deer, were an important animal protein resource for the KCV residents. If Cervidae are included in this biomass estimate, approximately 72% of the total sample biomass is comprised from Cervidae and white-tailed deer. While the taxonomic family Cervidae may represent elk, deer are the most likely member of this family to be readily available for local and non-local hunting.

Overall, the combined total NISP for fish makes up approximately 37% of the sub-sample NISP but only 12% of the biomass. Therefore, while fish genus and species are well represented within the assemblage, these animals were not as heavily relied upon as deer as a protein resource. The fish species represented come from a variety of aquatic habitats, and therefore were likely captured using a variety of techniques (e.g., hook and line, net weir).

Much of the fish at KCV are members of the family Centrarchidae- varieties of bass, sunfish and crappie. Additionally, a variety of catfish, suckers, perch and pike were recovered. The variety of fish types and general sizes show a preference for a diversified diet and capture plan. Like CBHC, the KCV site inhabitants were fishing with a variety of techniques to target both bottom-dwellers, shallow water, deep water, and those preferring vegetative waters. Fishing for bottom-dwelling fish could have been conducted using hook-and-line. Additionally, net weirs would have provided a delayed capture technique, allowing for the site inhabitants to gather wild rice or shellfish nearby and then check net weirs or set lines before and afterward these pursuits. These fish were likely caught at the shores of Lake Koshkonong, and therefore may have been provided by the residents of CBHC or fish were utilized to a lesser degree overall based on the further proximity to the lake. Of note, Lake Koshkonong is within a reasonable walking distance to/from the site.

Medium mammals at the site include those found typically alongside field edges, forests, and river or lakeshores (e.g., raccoon, rabbits, beaver, muskrat, squirrels). Such animals provided pelts and a supplementary protein resource. Raccoon, beaver and muskrat could all have been trapped along the shores of Lake Koshkonong or in adjacent wetlands. Rabbits, raccoon and deer would have also been attracted to field edge areas or found near forests or oak savannas. As such, these mammals may have been trapped or hunted during other daily pursuits (e.g., agriculture, collecting shellfish, fishing, gathering wild rice). Badgers are well-represented in the assemblage, which would have been able to be trapped in the oak savanna near the site.

The bird sample at KCV shows an emphasis is on waterfowl (Table 6.25). Waterfowl would seasonally nest along the wetlands and banks of Lake Koshkonong, making them semi-reliable protein resources during the spring and summer months. Waterfowl are often found at Oneota sites. The emphasis on perching birds may have been pursued for feather harvesting, practice in bird hunting by children, or as pest control during agricultural planting seasons.

Of the reptiles most of the turtles would have easily been found alongside watersheds, sunning themselves on rocks or logs, and may have been netted. However, box turtles are also often found along forest edges.

Table 6.25. KCV Species Summary Data

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass	Proportion
MAMMALIA (Mammals)						
Artiodactyla	13	0.06%	27.61	0.07%	26.8924	0.06%
Cervidae	2,569	12.18%	6,157.19	16.48%	7662.281	16.22%
Bison bison (bison)	2	0.01%	13.16	0.04%		0.00%
Odocoileus virginianus (deer)	4,287	20.33%	14,847.92	39.74%	18377.86	38.89%
cf. Odocoileus virginianus	1,607	7.62%	6,476.48	17.34%	8059.62	17.06%
Cervus elaphus	33	0.16%	79.15	0.21%	73.6089	0.16%
cf. Cervus elaphus	4	0.02%	29.37	0.08%	36.5493	0.08%
Carnivora	26	0.12%	53.43	0.14%	66.4907	0.14%
Ursus						
cf. Ursus americanus (American black bear)	1	0.00%	6.72	0.02%	8.3627	0.02%
Canidae (dog, wolf)	24	0.11%	69.72	0.19%	86.7627	0.18%
Vulpes						
Vulpes (red fox)	32	0.15%	66.72	0.18%	83.0293	0.18%
Procyonidae						
Procyon lotor (raccoon)	362	1.72%	701.49	1.88%	872.9653	1.85%
Mustelidae (mustelids)	2	0.01%	6.14	0.02%	7.6409	0.02%
Lontra canadensis (river otter)	1	0.00%	1.02	0.00%	1.2693	0.00%
Taxidea taxus (American badger)	126	0.60%	336.72	0.90%	419.0293	0.89%
Felinae (felines)						
Lynx (bobcats, lynx)						
Lynx rufus (bobcat)	3	0.01%	3.16	0.01%	3.9324	0.01%
Didelphimorphia						
Didelphidae (opossums)						
Didelphis marsupials (American opossum)	1	0.00%	4.28	0.01%	5.3262	0.01%
Lagomorpha (hares, rabbits)	113	0.54%	205.73	0.55%	256.0196	0.54%
Leporidae (cottontails)	205	0.97%	308.77	0.83%	384.2471	0.81%
Sylvilagus floridanus (eastern cottontail)	434	2.06%	718.42	1.92%	894.0338	1.89%

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass	Proportion
Rodentia	508	2.41%	804.11	2.15%	1000.67	2.12%
Castoridae						
Castor (beavers)						
Castor canadensis (American beaver)	326	1.55%	683.28	1.83%	850.304	1.80%
Cricetidae						
Ondatra (muskrats)						
Ondatra zibethicus (common muskrat)	1,004	4.76%	981.63	2.63%	1221.584	2.59%
Sciuridae (squirrel, chipmunk)	634	3.01%	405.72	1.09%	504.896	1.07%
Sciurus (tree squirrels)	207	0.98%	116.97	0.31%	145.5627	0.31%
Sciurus carolinensis (gray squirrel)	18	0.09%	9.81	0.03%	12.208	0.03%
Tamias	97	0.46%	63.44	0.17%	78.9476	0.17%
Tamias striatu (eastern chipmunk)	28	0.13%	16.2	0.04%	20.16	0.04%
TOTAL	**12667**	**60.07%**	**33194.36**	**88.85%**	**41160.2**	**87.10%**
AVES (Birds)						
Anseriformes (duck, geese, swan, waterfowl)	13	0.06%	9.41	0.03%	14.8936	0.03%
Anatidae (duck, geese, swan)	26	0.12%	11.46	0.03%	18.9196	0.04%
Anas (dabbling ducks)	139	0.66%	67.8	0.18%	100.6351	0.21%
Anas platyrhynchos (mallard)	164	0.78%	56.48	0.15%	82.586	0.17%
Aix (wood ducks)						
Aix sponsa (wood duck)	89	0.42%	67.44	0.18%	98.279	0.21%
Aythya (diving ducks)						
Aythya affinis (lesser scaup)	32	0.15%	16.5	0.04%	26.3743	0.06%
Branta (brent geese)						
Branta canadensis (Canada goose)	26	0.12%	16.89	0.05%	26.5715	0.06%
Galliformes (fowls)						
Phaisanidae (partridge, turkey, grouse)						
Phasianinae (pheasants)	2	0.01%	1.04	0.00%	2.0069	0.00%
Phasianus colchicus (ring necked pheasant)	3	0.01%	2.05	0.01%	3.7216	0.01%
Meleagris (turkeys)						

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass	Proportion
Meleagris gallopavo (wild turkey)	1	0.00%	2.06	0.01%	3.7381	0.01%
Columbiformes (doves, pigeons)						
Columbidae (doves, pigeons)	2	0.01%	0.98	0.00%	1.9013	0.00%
Ectopistes (passenger pigeons)						
Ectopistes migratorius (passenger pigeon)	1	0.00%	0.16	0.00%	0.3654	0.00%
Passeriformes (perching birds)	22	0.10%	6.48	0.02%	11.5855	0.02%
Corvidae (crows, jays, magpies)						
Corvus (crows)						
Corvus brachyrhyncho (American crow)	3	0.01%	2.16	0.01%	3.9029	0.01%
Suliformes (cormorants)						
Phalacrocoracidae (cormorants, shags)						
Phalacrocorax (cormorant)						
Phalacrocorax auritus (double-crested cormorant)	4	0.02%	3.28	0.01%	5.7079	0.01%
Accipitriformes (hawks, eagles)						
Accipitridae (hawk, eagle)	1	0.00%	0.98	0.00%	1.9013	0.00%
Accipiter (bird hawks)						
Accipiter cooperii (Cooper's hawk)	2	0.01%	1.42	0.00%	2.6645	0.01%
Stringiformes (owls)	1	0.00%	1.22	0.00%	2.3207	0.00%
TOTAL	**531**	**2.52%**	**268**	**0.72%**	**408**	**0.86%**
Teleostei (Boney Fish)						
Perciformes (perch-like fishes)						
Centrarchidae (sunfish, lobina)	3,124	14.82%	1,049.26	2.81%	1180.959	2.50%
Lepomis (common sunfish)	672	3.19%	326.57	0.87%	464.8919	0.98%
Lepomis gibbosus (pumpkinseed)	104	0.49%	79.06	0.21%	137.8697	0.29%
Lepomis macrochiru (bluegill)	246	1.17%	100.26	0.27%	161.4536	0.34%
Lepomis cyanellu (green sunfish)	137	0.65%	65.17	0.17%	115.587	0.24%
Ambloplites (rock basses)						
Ambloplites rupestri (rock bass)	107	0.51%	99.31	0.27%	168.5976	0.36%
Micropterus (bass)	429	2.03%	357.18	0.96%	467.7709	0.99%

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass	Proportion
Micropterus salmoidae (largemouth bass)	294	1.39%	182.06	0.49%	285.1714	0.60%
Micropterus dolomieu (smallmouth bass)	283	1.34%	189.2	0.51%	287.4111	0.61%
Pomoxis (crappies)	116	0.55%	64.52	0.17%	113.675	0.24%
Pomoxis nigromaculatus (black crappie)	104	0.49%	90.27	0.24%	157.3238	0.33%
Percidae (true perches)	102	0.48%	76.18	0.20%	131.8584	0.28%
Perca flavescens (yellow perch)	163	0.77%	77.52	0.21%	117.8761	0.25%
Sander viteus (walleye)	122	0.58%	62.05	0.17%	116.8908	0.25%
Sciaenidae (croakers, drum)	61	0.29%	43.8	0.12%	99.3946	0.21%
Aplodinotus (river drum, freshwater drum)						
Aplodinotus grunniens (freshwater drum)	80	0.38%	73.19	0.20%	137.1999	0.29%
Lepisosteiformes						
Lepisosteidae (gar pikes, gar)						
Lepisosteus (slender gar)						
Lepisosteus osseus (longnose gar)	3	0.01%	3.05	0.01%	11.1395	0.02%
Siluriformes (silures, catfish)						
Ictaluridae (catfishes)	331	1.57%	201.44	0.54%	262.2287	0.55%
Ameriurus (bullheads)	314	1.49%	104.16	0.28%	142.34	0.30%
Ameiurus nebulosus (brown bullhead)	116	0.55%	98.72	0.26%	135.3891	0.29%
Ictalurus (channel catfish, forktail catfish)	27	0.13%	20.41	0.05%	29.9267	0.06%
Ictalurus punctatus (channel catfish)	184	0.87%	109.42	0.29%	148.955	0.32%
Cypriniformes (minnow, sucker)	286	1.36%	101.14	0.27%	167.3423	0.35%
Cyprinidae (shiner)	201	0.95%	119.44	0.32%	203.4134	0.43%
Catostomidae (suckers, catostomes)	23	0.11%	13.67	0.04%	34.9194	0.07%
Moxostoma (redhorse suckers)	61	0.29%	41.52	0.11%	86.0443	0.18%
Catostomus (common sucker)	34	0.16%	15.54	0.04%	36.8037	0.08%
Catostomus commersonii (white sucker)	14	0.07%	7.36	0.02%	17.549	0.04%
Esociformes (mudminnows, pikes)	12	0.06%	6.58	0.02%	18.5706	0.04%
Esocidae (pickerels, pikes, brochets)						
Esox (pikes)	17	0.08%	18.03	0.05%	37.5412	0.08%
Esox lucius (northern pike)	32	0.15%	20.39	0.05%	46.1209	0.10%

Taxa	NISP	Proportion	Weight (g.)	Proportion	Biomass
TOTAL	7,799	36.99%	3,816	10.22%	5,522	11.69%
REPTILIA (Reptiles)					
Testudines (tortues, turtles, terrapins, tortoises)					
Emydidae (pond turtles, terrapins)	16	0.08%	16.07	0.04%	38.3498	0.08%
Chrysemys pict (painted turtles)	2	0.01%	1.77	0.00%	7.3065	0.02%
Graptemys (map turtles)					
Graptemys geographica (northern map turtle)	16	0.08%	17.82	0.05%	42.9342	0.09%
Chelydridae (snapping turtles)					
Chelydra serpentina (snapping turtle)	33	0.16%	36.4	0.10%	74.9988	0.16%
TOTAL	67	0.32%	72.06	0.19%	163.5893	0.35%
Amphibia (Amphibians)					
Anura (frogs, toads)	18	0.09%	7.39	0.02%		
Ranidae (riparian frogs)					
Lithobates catesbeianu (American bullfrog)	4	0.02%	2.02	0.01%		
TOTAL					
ASSEMBLAGE TOTAL	21,086	100.00%	37,360	100.00%	47,254	100.00%

Deer Body Parts

At KCV, the NISP values indicate a preference for undifferentiated lower limb elements, but the MNE values show a relatively even distribution of deer body parts (Table 6.26 and Figure 6.7).

The MNE ratio of cranial to upper limbs is 31:745. This very skewed ratio means it is likely that the hunting occurring at KCV was non-local. Cranial elements are not generally brought back to sites over longer distances, but groups will bring back larger meat packages, as are associated with upper limb elements. At KCV, there may be a combination of opportunistic garden-side hunting and coordinated hunting trips. Alternatively, if groups at CBHC were pursuing local deer, deer may have been butchered at CBHC and larger meat packages brought to KCV. If this strategy was occurring, then the site inhabitants at CBHC and KCV would have coordinated a combined subsistence strategy, likely related to both animal protein and plant production and gathering.

Table 6.26. KCV Deer Body Parts

Body Parts	**NISP**	**Proportion**	**MNE**	**Proportion**
Cranial	382	6.48%	31	1.31%
Axial	1197	20.31%	602	25.52%
Upper Limb	1524	25.86%	745	31.58%
Lower Limb	2791	47.35%	981	41.59%
Total	5894	100%	2359	100%

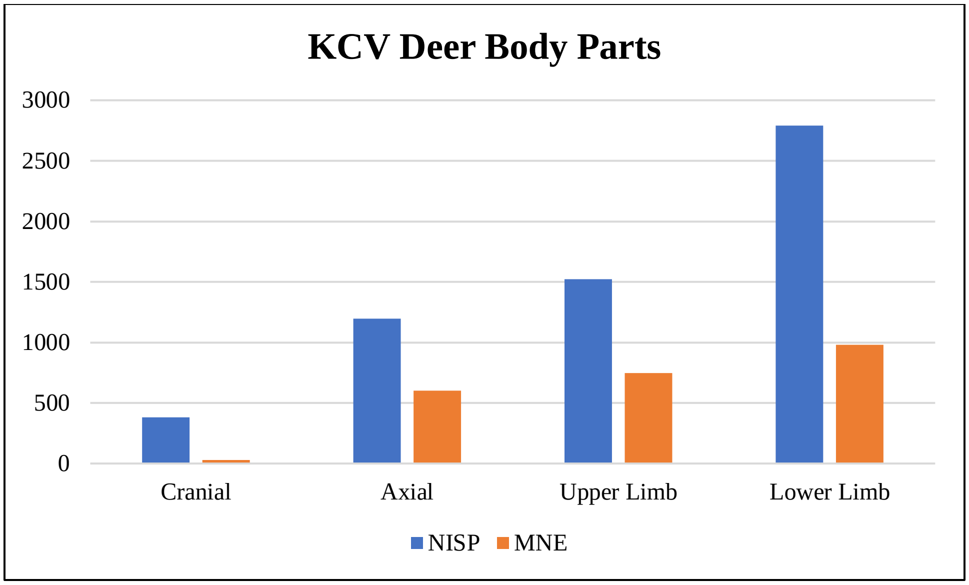

Figure 6.7. KCV Deer Body Parts

Deer Mortality Profiles

The KCV deer sample represent both mature and juvenile deer (Table 6.27). The mature deer would have provided enough meat to provide a larger amount of protein per meat package. It appears the site occupants were targeting adult deer but not excluding the hunting of yearlings and fawns. In this case, fawns and yearlings were not being saved for future hunting endeavors. Therefore, it may be the case that at some points in time, the site occupants were targeting deer without regards for future hunting or sustaining their local deer populations. This may be the result of a local resource depression, a bottle-necking or restriction of resource acquisition areas due to inter-group conflict, or both. Further, the capture of both mature and juvenile deer means that hunting was a year-round practice and not restricted solely to autumn- when deer are at their largest.

Table 6.27. KCV Deer Mortality Profiles

Deer Mortality Profiles		
Elements	**Age Range**	**NISP**
Lower milk 3rd premolar has erupted and shows wear	18-24	8
Lower 2nd permanent premolar erupted	30	14
Only five erupted teeth	6	6
Coronal Suture- half-fused	6	1
Sagittal Suture- unfused	6	3
Sagittal Suture- half fused	20	2
Sagittal Suture- fused	24	3
Humerus, Prox- fused	26-38	8
Humerus, Prox- unfused	<26	8
Humerus, Dist- unfused	13-18	10
Femur, Dist- unfused	23-29	6
Femur, Dist- half fused	29-47	2
Lumbar Vertebra, unfused centrum epiphysis	<17	18
Thoracic Vertebra, unfused centrum epiphysis	<23	6
Radius, Prox- half-fused	2-5	1
Metapodial, Prox-half-fused	1-4	26

The deer mortality profiles at KCV may demonstrate an age-selective hunting strategy. There is not a dominance of prime age deer represented, which would be expected with an OFT model and more yearlings than expected. The high number of yearling bones represented may be due to the local hunting strategy, where yearlings are likely to be attracted to agricultural fields and gardens but not yet savvy enough to evade hunters. This assertion is based on both animal behavior and the paleobotanical evidence for higher amounts of maize at KCV. therefore, it is possible the site occupants were hunting for a combination of pest control, efficiency to expend the most time and labor close to home, as opposed to regular coordinated hunting events.

Summary of KCV

Overall, the KCV site vertebrate assemblage shows as emphasis on upland hunting (e.g., deer) with a lesser emphasis on aquatic resources than CBHC and Schemling. This differentiation may be due to the further distance of KCV from Lake Koshkonong. However, the larger focus on terrestrial mammals at KCV mirrors the paleobotantical samples analyzed by Edwards (2017). Edwards found higher proportions of maize at KCV when compared with CBHC. Thus, the emphasis on field-edge mammals (e.g., deer, raccoon) may be a reflection for the site occupants at KCV focusing their efforts on agricultural pursuits.

Summary of Lake Koshkonong Oneota

Overall, the case study sites in the Lake Koshkonong Locality show evidence for differences in site function based on the vertebrate assemblages. At first glance, these assemblages appear typical of general Oneota sites reported within Wisconsin, however when examined in detail, these assemblages reveal some cultural divergences, potentially linked to their isolated location in relation to other Oneota localities or inter-site functional differences.

Worked Fauna

Examples of worked fauna for these dissertation site samples were recovered exclusively within the Lake Koshkonong Locality, at CBHC and KCV. These sites had the largest vertebrate and invertebrate assemblages studied. The worked fauna are discussed within specific categories for vertebrate remains and then invertebrate examples are discussed separately. The vertebrate categories are morpho-functional in nature (i.e., tools, adornment, agricultural, undifferentiated). The only worked invertebrates were recovered at KCV and were compared with worked invertebrate images and descriptive reports for Woodland, Oneota, and Historic sites in the region to best categorize these specimens.

Crescent Bay Hunt Club Worked Vertebrates

At CBHC, mammal and bird elements are used for technology manufacture, however, mammal elements dominate the sample (Table 6.28). Based on this sample, CBHC shows little evidence of formal awl manufacture and preference towards expedient awl manufacture.

Table 6.28. CBHC Vertebrate Tool Summary

Taxa	**Category**	**N**
Mammal	Undifferentiated	6
Bird	Undifferentiated	3
Mammal	Formal Awl	2
Mammal	Expedient Awl	1
TOTAL		***12***

Mammal elements were likely the by-product results of hunting activities, potentially local and non-local. The elements that could be identified were antler, horn, and metapodials, although other elements may have been used but no skeletal identifiers were left post-manufacture (Figure 6.8). Metapodials are often associated as either the result of local hunting and butchering, as they are not the attachment points for meatier region of large mammals (Binford 1977). However, ethnographic and ethnohistoric accounts have mentioned their utility in both marrow extraction and tool use, and as such have been the subject of research around the world (e.g., Binford 1962, 1977; Dean 2015; Lyman 1984; Shipman and Rose 1988; Yellen et al. 1995). As tool preforms, metapodials are relatively dense, there are more per large mammal body than other elements (e.g., two scapulae vs 16 longer metapodials). For these reasons, metapodials are often recovered at archaeological sites throughout prehistory, and globally have been used in tool manufacture. Additionally, large mammal elements often favored in tool manufacture are also denser, thus more often biased toward recovery in the archaeological record (see Binford 1970; Morlan 1994; Lyman 1984).

Figure 6.8. CBHC Vertebrate Tools

The morpho-functional categories present at CBHC based on this sample are limited to expedient awls and undifferentiated worked fauna. The undifferentiated category is split between bird and mammal elements. These specimens may have been formal or expedient tools with characteristic markers obscured by post depositional processes, tools broken during use and then discarded, mistakes or broken pieces from failed tool manufacture, or the byproducts of larger manufacturing processes (Figure 6.9).

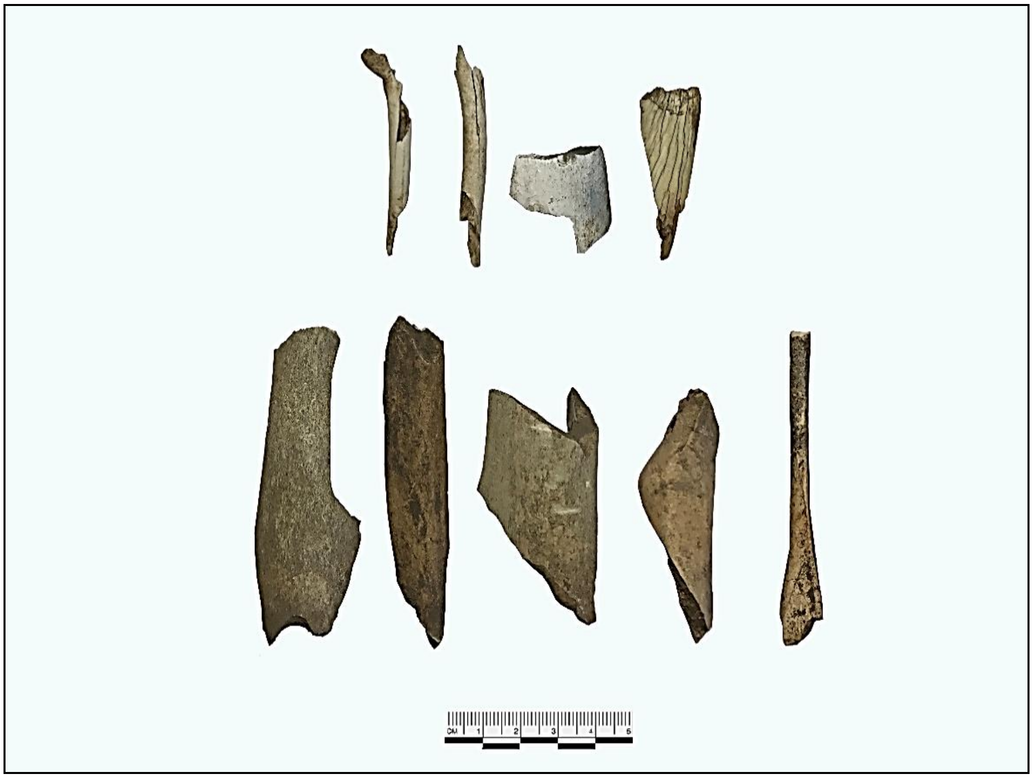

Figure 6.9. CBHC Undifferentiated Worked Vertebrates

The expedient awl at CBHC was manufactured from mammal bone (Figure 6.10). This splinter or expedient awl may have been the byproduct of marrow extraction. This can occur when hammerstones are used to smash fresh bone and often some elongated sharp shards of bone are removed in the process. As in flintknapping, flakes are often used as expedient tools, especially during bipolar reduction, bone flakes of a particular-shape and edge would have sometimes been useful for tool use (Bignon-Lau and Lázničková-Galetová 2016; Dean 2015; Olsen 1979; St-Pierre 2007). These expedient awls might have been used in an analogous manner as formal awl for a variety of tasks, such as hide puncturing, as needles, for ceramic incising, basket and mat weaving (see Olsen 1984; St-Pierre 2007).

Figure 6.10. CBHC Expedient Awl

The main difference between formal and expedient awls parallels their lithic counterparts. Formal awls take longer to manufacture, and with this longer time investment, they likely move between encampments as people move on the landscape, are likely sharpened and reused over time, and often not discarded until their uselife has been relatively exhausted- likely in a location removed from their place of manufacture (Bamforth 1986; Binford 1977; Dean 2015; Falk 1969; Maigrot 2003; Odell 1996; Olsen 1979; Shott 1986) (Figure 6.10). Expedient awls by nature are likely used for a short duration and then discarded. In the case of splinter awls, they are still likely discarded in the same expected fashion as their lithic counterparts, likely as part of a larger cleaning event (Maigrot 2003). At CBHC, there were more formal awls than expedient ones (Figure 6.11). These were manufactured from large mammals and may have served a similar purpose to expedient tools.

Figure 6.11. CBHC Formal Tools

Overall, the CBHC worked vertebrate assemblage, given the very large assemblage size, the amount of worked specimens seems small. However, these specimens represent both expedient and formal tools, which indicates a mixed technological organization with regards to bone tools. Additionally, the undifferentiated worked fauna comes from both mammal and bird bones, meaning a variety of animals were utilized beyond their caloric potential.

KCV Worked Vertebrates

The KCV worked vertebrate sample shows an emphasis on mammal elements as a raw material for tool and personal adornment manufacture (Table 6.29 and Figure 6.12). The site occupants also favored expedient awl manufacture over formal tools. The samples recovered from KCV show a greater variety of morpho-functional categories than the sample from CBHC. KCV also exhibits evidence of clear use of vertebrate remains for personal adornment and agricultural technology.

Table 6.29. KCV Worked Vertebrate Summary

Taxa	Category	N
Mammal	Undifferentiated	4
Bird	Undifferentiated	3
Mammal	Formal Awl	2
Mammal	Expedient Awl	5
Mammal	Adornment	3
Mammal	Agricultural	3
Mammal	Possible Point	2
TOTAL		***22***

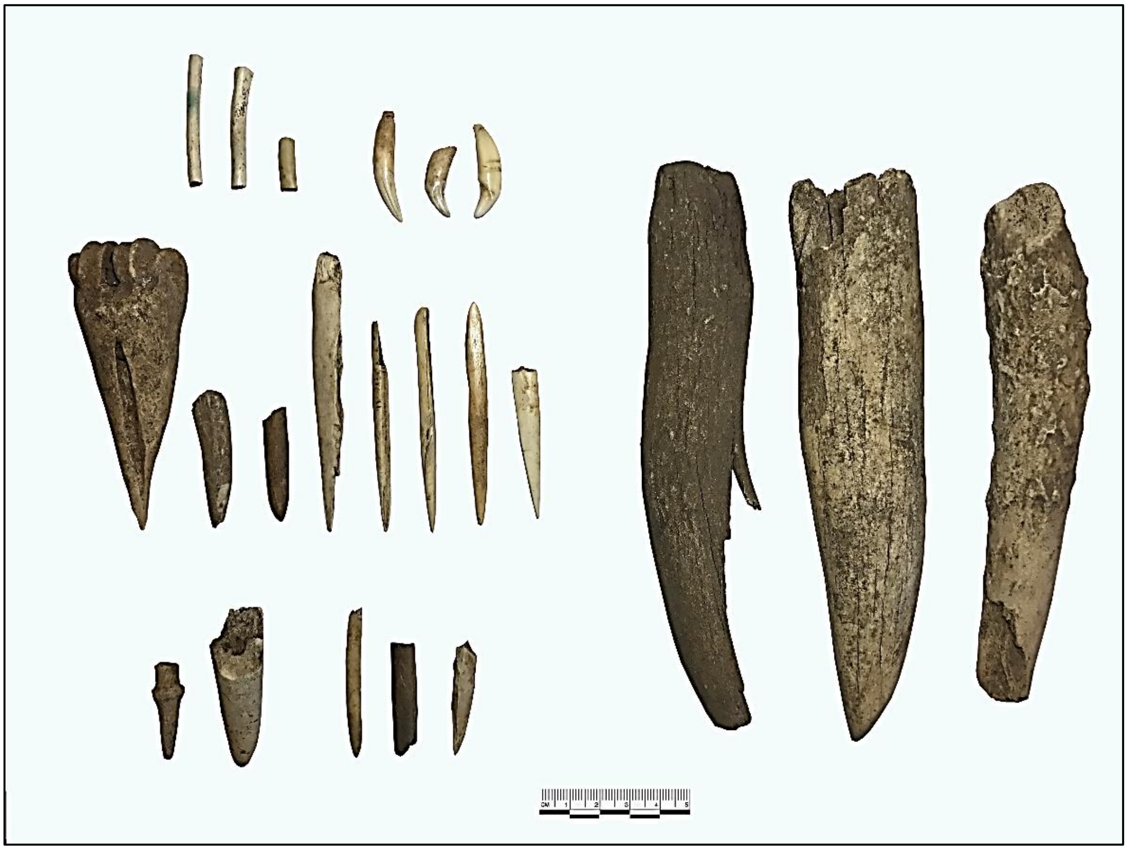

Figure 6.12. KCV Worked Vertebrate Specimens

All expedient awls at KCV were manufactured from mammal bone (Figure 6.13). Bird splinter awls have been reported in the region but are not as often recovered archaeologically due to their more fragile nature and are often made from larger waterfowl (e.g., swan, goose, crane)

Figure 6.13. KCV Expedient Tools

(Falk 1969; Olsen 1980). Expedient awls may have been the byproduct of marrow extraction. These expedient awls were likely used in a comparable manner to formal awls for a variety of tasks, such as hide puncturing, as needles, for ceramic incising, basket and mat weaving (see Olsen 1984; St-Pierre 2007).

Formal awls take longer to manufacture, and with this longer time investment, they likely move between encampments as people move on the landscape. The formal awls at KCV were manufactured from large mammal bone, one of which was manufactured from a deer metapodial (Figure 6.14).

Figure 6.14. KCV Formal Tools

The only cases of adornment include canines from carnivores, most likely bobcat or lynx (Figure 6.15), and three bird bone beads (Figure 6.16). In the case of the pendants, there is the same potential type of fastening to either be worn as a pendant or fastened to clothing. One canine shows evidence of working but the stringing area was removed. One shows evidence of being a finished pendant. The third canine has striations on one end of the root end of the tooth, indicative of creating a perforated surface around the top to have a cord tied around it to either fasten to clothing or be worn as a pendant with the tip hanging down. This canine also shows repeated evidence of being cut into on two other areas of the tooth surface. The pendant does not appear to have been finished, as the inferred perforation area is only present on one half of the root end. Ethnohistoric and ethnographic accounts in the region have suggested a special importance on carnivores, specifically canines and felines (see Brown 1997; Hall 1997;

Wonderley 2005). These pendants possibly had non-utilitarian significance to their original owners.

Figure 6.15. Feline Canines

Figure 6.16. Bird Bone Beads

The bird bone beads from KCV are typical tubular beads, with a similar shape to those from Archaic and Woodland sites (see Theler et al. 2016). The ends show possible evidence of groove-and-snap manufacturing technique. The two longer beads are from a bird ulna, of approximate a member of the genus *Anas* (e.g., mallard, wood duck). *Anas* is the dominate type of waterfowl genus recovered at the site (McTavish et al. 2016). Bird bones are often used as preforms for tubular beads. This is likely due to their natural morphology as light weight, already in the approximate tubular shape, very often shiny when cleaned, and in the case of ulnas- there is very little smoothing, and work needed to remove the articular ends.

The copper staining on the bird tubular bead on the far left (Figure 6.16), is likely prehistoric. This stain could be the result of prolonged contact with some copper adornment (e.g., other pendant, bead, fastener). The likelihood of it being the result of modern contact with copper is unlikely, since it came from an intact feature deposit.

The only cases of agricultural technology are three digging sticks from large mammals and were recovered at the KCV site (Figure 6.17). These tools likely came from a *Cervidae*, which may have been hunted locally or the antlers transported with meat from longer-distances when they were needed as raw materials. There are no scapula hoes recovered at any site in this locality, including previous faunal reports for the region (Hall 1962, Hunter 2002, Jeske et al. 2003; Rodell 1984). Scapula and shell hoes have been reported at other Oneota sites in Wisconsin and Illinois, as well as the nearby Late Woodland and Middle Mississippian site of Aztalan (Gibbon 1986; Jeske1989; McTavish 2013; O'Gorman 1993; Sasso 1993; Theler and Boszhardt 2006a,b; Theler 2000, 2016). Deer scapulae and the freshwater mussel shells typically used as shell hoes (three ridge) were recovered within the CBHC and KCV faunal assemblages. Therefore, it is the agricultural techniques employed that were the deciding factor in not utilizing hoe technology rather than availability.

Edwards (2010) indicates that both sites are in areas of relatively little traditional agricultural potential- accounting for soil drainage and prairie grass roots- difficult to till with bone, stone, and wooden tools. In the Lake Koshkonong Locality, the choice of digging sticks, while divergent from other Wisconsin Oneota localities, is consistent with Langford groups in northeastern Illinois. Jeske (1989) has attributed a connection in Illinois the divergences between Langford and Fisher agricultural technology, and the use of hoes versus digging sticks, is associated with local soil drainages.

Figure 6.17. Horn and Antler Digging Sticks

While the only agricultural tools in the locality come from KCV, this does not mean that agricultural pursuits were not practiced by the site occupants at CBHC. It is possible that there is a sample bias, or alternatively that fields could be better tended in the more upland area surrounding KCV.

Worked Shell/Shell Technology

Six bivalve shell pigment applicators were identified at KCV. Two were identified in Feature 12-01 and four in Feature 12-06. Those from 12-01 were all red ochre pigment applicators, while those from 12-06, two were red ochre applicators and two were used for galena. This type of tool was first identified at Oneota sites in Iowa and then in the LaCrosse locality by James Theler (see Lamb and Theler 2012). However, the pigment applicators identified by Theler were exclusively red ochre applicators. The galena applicators conform to Theler's pigment applicator criteria, but instead of ochre pigment remains, the pigment remains are silvery like the local mineral galena.

The presence of these artifacts demonstrates that shellfish was used for a purpose beyond the usual ceramic tempering found within this locality. The mussel shells used as applicators were all Three-Ridge (*Amblema plicata*). These local mussels are relatively robust, and the pigment and use polish, as seen under low power microscopy, is always present on the dorsal umbo.

Overall, the KCV invertebrate assemblage composed of local mussel shells and the general assemblage is dominated by bivalves. Four taxa were relatively well represented: Spike (*Elliptio dilatate*), Fat Mucket (*Lampsilis siliquoidea*), Three Ridge (*Amblema plicata*), and Yellow Sandshell (*Lampsilis tere*). The GMax data indicate an overall trend through time to target mature adults. It is possible that mussel bed maintenance was practiced consistently, or relatively long periods of time.

The use of local mussel shell as a technological choice in temper, especially given the choice to exclude shellfish as a tempering agent by Langford groups, indicates an active choice to continue a technological continuity with a larger pan-Oneota cultural and ethnic identity tradition. There are few examples of worked shell in the Lake Koshkonong Locality (6 applicators at KCV). However, it is important to note that Lasley's Point, an Oneota site in the Lake Winnebago locality to the north, has evidence of both shell tempering and shell modifications (e.g., shell spoons) (Gibbon 1970, 1972; Overstreet 1978), and the nearby Aztalan site has evidence of shell modification in addition to its use as a ceramic temper (e.g., shell beads, shell hoes) (Leigl 2014; McTavish 2013; Theler 1991; Warwick 2002).

While pigment applicators have been recovered from Oneota sites along the LaCrosse River Valley, the pigment applicators identified by Theler were exclusively red ochre applicators. The galena applicators recovered at KCV conform to Theler's pigment applicator criteria, but instead of ochre pigment remains, the pigment remains are silvery like the local mineral galena. Galena cubes have been found in the Lake Koshkonong locality, and therefore this is the likely mineral pigment used with these tools (Sterner 2012a).

The presence of these artifacts connects shellfish use to the use of shell as a raw material used for a social or ritual purpose. On whom or what pigment was applied remains unclear, but it may have been applied to living humans as part of body decoration. However, there is no skeletal evidence with galena or ochre stains from Oneota burials at CBHC, KCV or Schmeling. One ceramic sherd at the Lake Koshkonong locality has evidence of red paint on the inside- pigments may have been mixed and/or stored in ceramic vessels, and then shell valves were used as the applicators onto the subject or medium to be adorned.

Until the identification of shell pigment applicators in the Lake Koshkonong Locality, no potential purpose as to the use of these galena cubes had been proposed. Galena cubes are grey or silver and used as a mineral used for pigment. While we cannot begin to conclude on whom or on what this pigment was applied to using these shells, we can infer that such an action likely had a more socially based purpose.

Interestingly, all reported pigment applicators for Iowa, LaCrosse, and those now identified in Lake Koshkonong have been exclusively on Three Ridge (*Lampsilis siliquoidea*) valves. These local mussels are relatively robust, and the pigment and use polish, as seen under low power microscopy, is always present on the dorsal umbo. The selective nature for choosing a particular species as a raw material for a particular tool type follows with the inference that this tool and the actions it was used for held a particular purpose in a social or ritual realm. This pan-Oneota species selection could be due to both the general size and rusticity of the shells, as well as their ubiquity among most small to large rivers and reservoirs- living in gravel, mud, and sand. Additionally, this selection can be interpreted as the strongest line of evidence for cultural continuity regarding shellfish use, beyond shell use as a tempering agent.

Fundamentally, the use of shell as a raw material in the Lake Koshkonong Locality, is only found as a tool used for a potentially non-economic purpose. In this manner, Lake Koshkonong Oneota use of shellfish can be used as a line of evidence when connecting to broader anthropological studies. Specifically, focusing in on the materialization of different perceptions of how the same natural raw materials can be appropriate for social or ritual pursuits, but not for technologically economic ones.

Ritual Fauna Deposits

Within the larger Mississippian ideological complex, archaeologists have used ethnohistoric sources to provide potential insights into the cognitive motivations for the complicated relationships individuals and groups have with animals in the physical and spiritual realms. The Southeastern Ceremonial Complex (SECC) ideology is based on a series of similar symbols throughout the Mississippian world, some of which crosscut the division between Middle and Upper Mississippian archaeological groups, (Hall 1997; Knight et al. 2001). These intersecting aspects of the SECC are the focus for the following discussion of potential ideological interpretations and rectification.

One of the most commonly referenced points of intersection among Upper and Middle Mississippian archaeological communities is the ethnohistoric connection to the cosmological beliefs of an upper and lower world dichotomy. In this dichotomy, similar to historic tribes in the Midwest and Southeastern United States, is a relationship between animals and their cosmological realm of habitation (including humans). These are divided into three realms: the underworld associated with the water, the Upper World with the sky, and the earth in the middle. Moving between these realms are spirits or cosmological beings that can be represented by, associated with, and take the physical form of different animals. Typically, within this upper and lower dichotomy, animals that move within these earthly manifestations are associated with the particular cosmological realm (e.g., birds in the Upper World, turtles in the Lower World). Depending upon the ethnohistoric reference, wolves, and more generally canids, are associated with the Lower World and transitional animals that live and move within aquatic and terrestrial zones (e.g., turtles) are able to move between the Lower World and the human plane of existence.

Domestic Dog Deposits

In the 2010 excavations at Crescent Bay, two distinctive animal deposits were recovered that are reminiscent of ethnohistoric descriptions by Radin (1923) of HoChunk feasting prior to and after raiding events- however this is not to imply a direct historic connection or direct analog.

In Radin's (1923) description of the HoChunk War Bundle Feast was an annual event held by each respective clan. The sacrifice itself was held in the private sphere prior to feast, and at the end of the feast a public ritual for the sacrificed dog occurred with all feast-goers in attendance (Radin 1923:403). The archaeological deposit at Crescent Bay is a dog burial, and through ethnographic analogy may cautiously be interpreted as a similar sacrifice. The burial was located at the bottom of a midden pit and had a prepared rock surface on which a relatively young (~3-4 years old) dog was deposited. The bones show cut marks, based on location are probable evidence of skinning, as would be expected in the preparation for the war bundle.

The second associated depositional context that also has a potential HoChunk analog is a deposit of a dog crania, deer leg, and bear cranial element. This is tentatively connected to the Hokier Dance, which occurred after war party returned with scalp. On the second day, a feast was prepared with deer, bear, and dog. The heads of these animals were considered sacred and individuals consuming meat of these elements or areas near the head were considered "enhanced" (Radin 1923:331-335). Both archaeological contexts are adjacent (within unit 10-03/09).

Eagle Deposits

Two eagle deposits were recovered at Crescent Bay Hunt Club site within Feature 04-22. Feature 04-22 is located near a Longhouse and not within a close proximity of the domestic dog deposits at the site.

It is possible that this eagle deposit were two separate deposits within the refuse midden. Based on the articulation of elements between joints, refits, and overall robusticity it is likely these two deposits were likely articulated at the time of deposition. The larger eagle deposit contains approximately ¾ of the entire skeleton and therefore it is likely the entire bird was deposited. The smaller eagle deposit was a left wing, consisting of the long bones which articulated together. The lack of phalanges is possibly due to taphonomy, archaeological sampling, or bioturbation.

It is not likely that the full eagle was consumed prior to burial, but it may have been harvested for feathers. The eagle the articulated wing originated from may or may not have been consumed. It likely served a ritual function- possibly as an ornamental wing, as a fan in ceremonies, and/or some other type of ritual context.

Eagles, and other raptors, are often associated with the sky or upper realm and to be creatures of cosmological power (see Benn 1989; Hall 1997). These animals are considered sacred among historic and current tribes (e.g., HoChunk, Menomonee, Potawatomi). The deposit of an eagle wing may have been a separate or incorporated within the same depositional episode.

Bird wings, especially larger birds are often found within ritual deposits, including but not exclusively associated with, mortuary rituals, feasting, and/or deposits associated with cleansing to prepare or bless the ground prior to or immediately after the construction of a structure (e.g., house, communal space) (see Mannermaa 2008; Parmalee 1967; Ubelaker and Edel 1975).

These eagle deposits may be associated with the nearby long house. Long houses at CBHC serve a function different from historic analogies or previous interpretations of their function as a seasonal house structure (Jeske and Sterner 2018). At CBHC, longhouses are likely communal spaces (Edwards 2017; Jeske and Sterner 2018).

Human and Deer Burial at Crescent Bay Hunt Club

In 2012, field school excavations at CBHC uncovered a unique burial. This was an inhumation within a shallow pit, a flexed burial of a young man with some elements missing (Table 6.30).

Table 6.30. CBHC Burial (B12-01) Skeletal Elements Present

Postcranial Bones and Joint Surfaces		
Element	**Left**	**Right**
Patella		x
Sacrum	x	x
Illium	x	x
Ischium	x	x
Pubis	x	x
Acetabulum	x	x
Auricular Surface	x	x

Vertebrae		
	Centrum	**Neural Arch**
T11	1	1
T12	1	1
L1	1	1
L2	1	1
L3	1	1
L4	1	1
L5	1	1

Ribs		
	Right	**Left**
1st	1	1
2nd	1	1
11th	1	1
12th	1	1

Long Bones		
	Right	**Left**
Left Humerus	x	x
Left Radius	x	x
Left Ulna	x	x
Left Femur	x	x
Right Femur	x	x

Foot		
	Left	**Right**
Talus	1	1
Calcaneus	1	1
Other Tarsals	3	1
Metatarsals	2	1
Phalanges	1	0

Hand		
	Left	**Right**
Carpals	5	0
Metacarpals	5	0
Phalanges	1	0

The missing cranium was replaced with a deer mandible and the left scapula was replaced with a deer scapula. These replacement elements were placed in anatomical position prior to burial. The deer antler projectile point was found within the burial pit. The injury resulting from this point likely contributed to the death of the individual. The association between the antler point and the deceased individual comes from the refit of the point into the iliac crest and the point was excavated within a few centimeters from the ilium (Figure 6.18). It is possible that the body still had the antler point lodged within the pelvis area during the burial.

Figure 6.18. Antler projectile point embedded in Illium

It is most likely that this individual was killed some distance from the site and not recovered for some time. This is evidenced by the scavenging marks on the bones. If this death occurred during a raid or a potentially more violent period in the region, those back at the village site may have not been able to recover the body until a later period. In this case, the missing elements may represent missing limbs dragged off by scavengers (e.g., wolves, fox, coyote, bobcat).

The possible cause of death being created from a deer and the replacement elements to the physical body upon burial being from a deer is interesting. There are many possibilities as to why that white-tailed deer elements were chosen as replacement elements for this individual. The death may have occurred in association with a coordinated hunting event, deer elements are roughly similar sized to human elements, it may be a clan or tribal affiliation. Regardless of the exact reason why deer elements were chosen, this burial is a terrific case study that speaks to the close human-animal-environmental relationship at the Lake Koshkonong Locality. Further, the dietary emphasis on deer is mirrored in the mortuary record, but in a manner, that reflects the complex and multipurpose utility of the animal itself. Animal and human combination burials, or the inclusion of animal body parts as grave goods are found throughout the Midcontinent dating from the Archaic through the Historic periods (e.g., Brown 1965, 1967, 2005; Griffin 1967; Mainfort 1985; Milner et al. 1991; O'Gorman 2001; Santure et al. 1990).

The Norris Farms 36 Cemetery site in the Central Illinois River Valley contains a large sample of human burials, some of which contained animal elements. At Norris Farms, the large mammals, including elk and deer, for both Woodland and Bold Consular groups were not used as replacements for any missing elements, but were instead generally modified as pins (Santure et al. 1990:232, 240-243). Like CBHC, at Norris Farms there were graves with projectile points (stone and bone) interred with the deceased individuals. Some of these may have been still in the body at the time of burial (Santure et al. 1990:106-107).

7. Discussion and Conclusions

The purpose of this chapter is to summarize and contextualize the results of this dissertation. Overall, it will lay out the case for cultural differences and adaptations between Wisconsin Oneota groups inhabiting Lake Koshkonong and Langford groups occupying Fox/Des Plaines Localities. Specifically, it will address of how each group interacted with their environment during a period of systemic inter-group conflict. These cultural adaptations helped to reinforce distinctions between the two groups, which are materialized archaeologically through their refuse and discard patterns, choice of site locations on the landscape, and how these groups interacted with, acquired, and managed their local resources. The criteria for distinct types of occupation, (i.e., site types) and the concept of place-making are also discussed. This discussion is framed by the five overarching research questions from Chapter 1. The answers identify larger themes and contributions, and proposed avenues of future research.

Question 1: Do the diets of Oneota and Langford groups in the Lake Koshkonong and Fox/Des Plaines localities support the notion that there was systemic violence across the landscape?

To address if this question, the adjusted Optimal Foraging Theory expectations and models are used. The three OFT expectations for groups under the threat of systemic violence are:

1) Optimal resources are those relatively close to the habitation site to minimize risk of venturing too far out of a designated safe zone
2) Optimal resources serve multiple functions (e.g., hides or furs, dense bones for tool manufacture, high-yields of grease or marrow for additional caloric intake).
3) Optimal resources are found where other subsistence or resource acquisition activities occur (e.g., near crop tending, clay resources, chert quarries)

Each of these expectations is addressed separately for clarity of argument and to examine if all three expectations are met for each locality. This allows for comparison between Oneota and Langford group strategies and the faunal assemblages meeting or not meeting these expectations.

Optimal resources are those relatively close to the habitation site to minimize risk of venturing too far out of a designated safe zone.

Local and non-local resources are animals that would be easily accessible within a close proximity to the site areas. General ecological niches and habitat areas are based on previous catchment models of the surrounding 2km distance from the sites as calculated by Edwards (2010) and Wilson (2016) (Table 7.1, Figure 7.1).Three primary lines of evidence were used to test this expectation: 1) comparison of general biomass per environmental niche; 2) deer body parts to examine local versus non-local hunting and processing; 3) deer mortality profiles were compared to examine age-selective or non-age-selective hunting strategies.

Table 7.1 Village Comparison: Available Ecological Zones

Sites	**Ecological Zones from 2km Circular Catchments**				
	Savanna	**Prairie**	**Wetland**	**Lake/River**	**Creek**
W. Irving	77%	9%	13%	0%	1%
CBHC	60%	11%	5%	22%	1%
KCV	84%	2%	12%	0%	2%

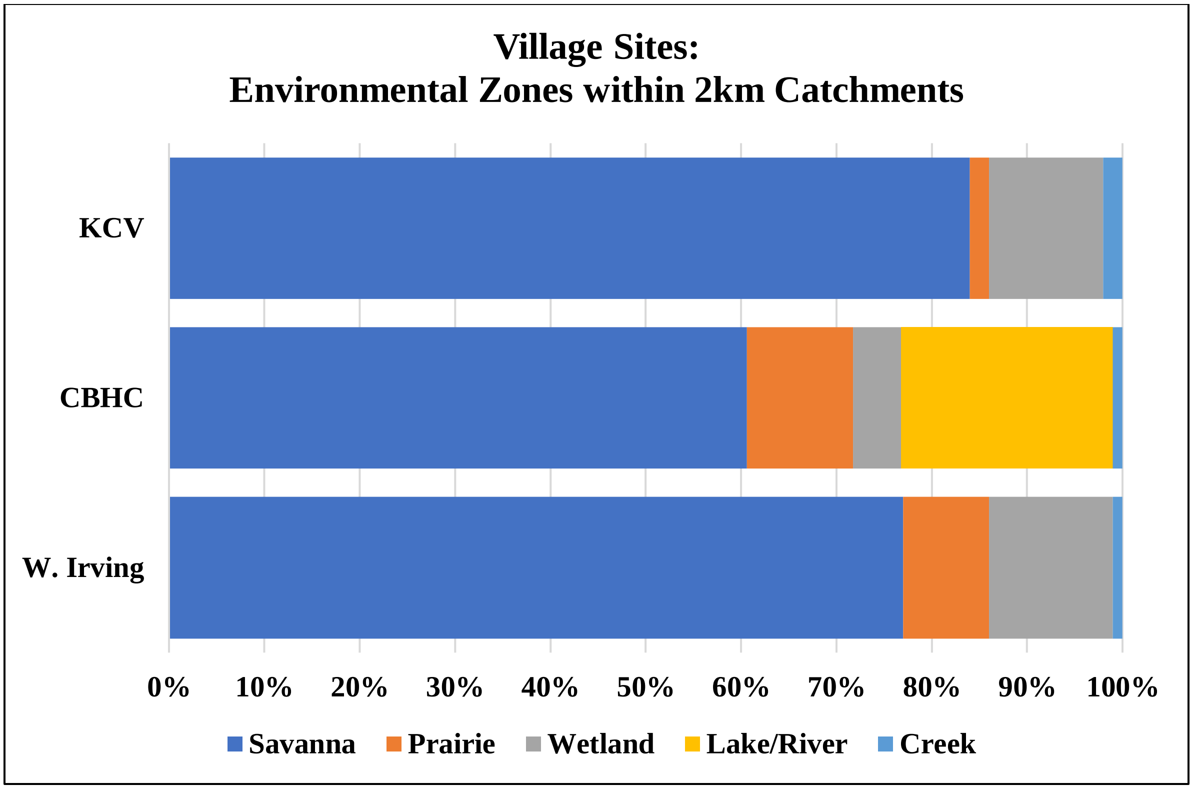

Figure 7.1 Village Site Comparison: Environmental Zones within 2km

Overall, the data indicate the inhabitants of village sites within both the Lake Koshkonong and Fox/Des Plaines Localities relied on local resources available within close proximity to sites. At Lake Koshkonong, CBHC and KCV both show a high reliance on fish and deer (Figure 7.2). CBHC has a higher proportional reliance on fish than KCV. Differing reliance on fish is related to the between the proximity of Lake Koshkonong to these respective villages.

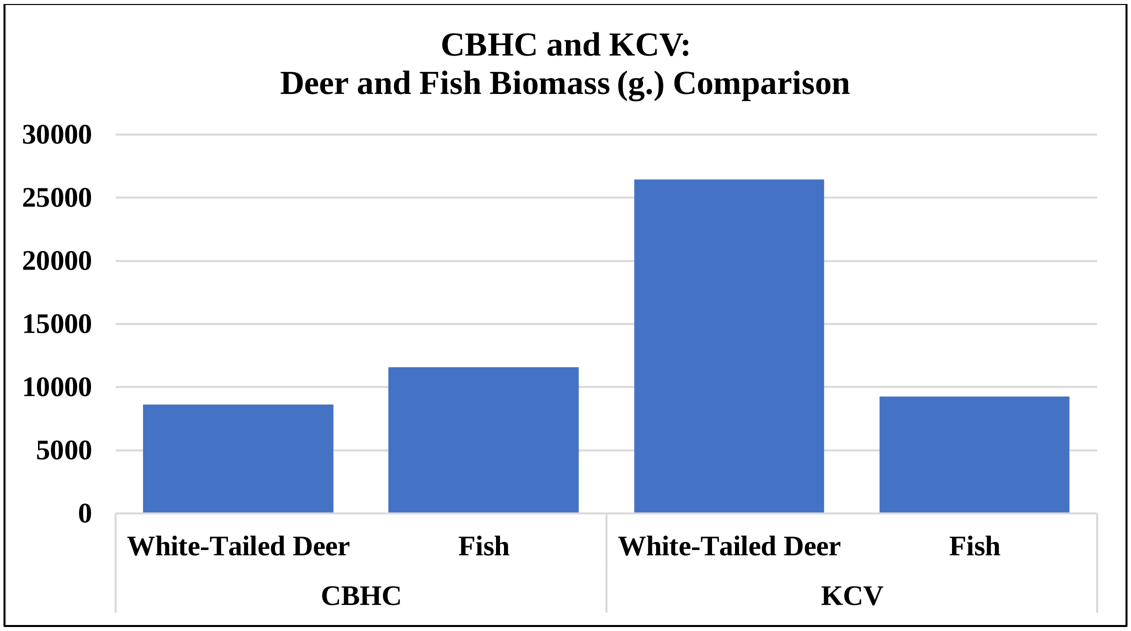

Figure 7.2 CBHC and KCV Deer and Fish Comparison

The deer body part and age selection data show different patterns between CBHC and KCV, rather than a consistent deer hunting strategy for the locality (Figures 7.3 and 7.4). At CBHC, there appears to be a non-age-selective hunting strategy. However, there are more yearlings than expected. This higher proportion of yearlings means it is possibly a local hunting strategy, as supported with the deer body parts MNE values. At KCV, the deer body part MNE data indicate that non-local hunting is more common than at CBHC. Furthermore, the KCV assemblage has an emphasis on yearlings and prime aged deer. This combined data indicates that there is not necessarily a straight-forward explanation for the hunting strategy at these sites. However, it is possible that there was a combined resource acquisition and hunting strategy occurring within the Lake Koshkonong Locality. It is plausible that deer were hunted locally at KCV and then processed on site and then body parts were transported or traded to CBHC for more aquatic resources (e.g., fish, shellfish, wild rice).

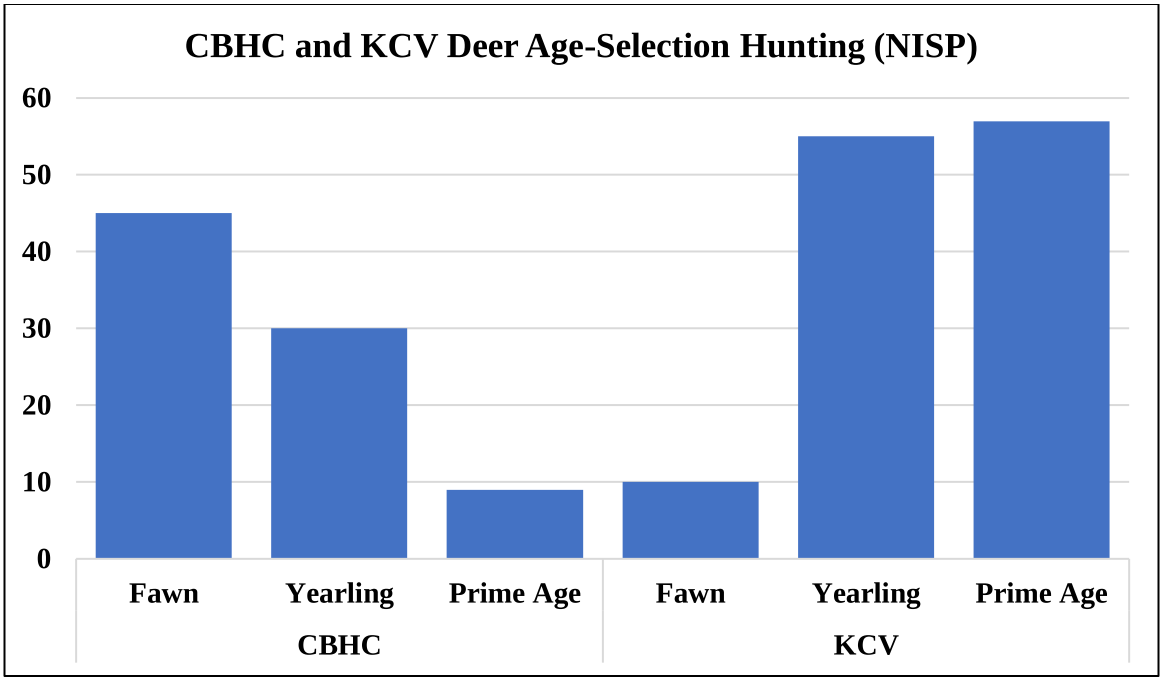

Figure 7.3 CBHC and KCV Age-Selective Deer Hunting Comparison

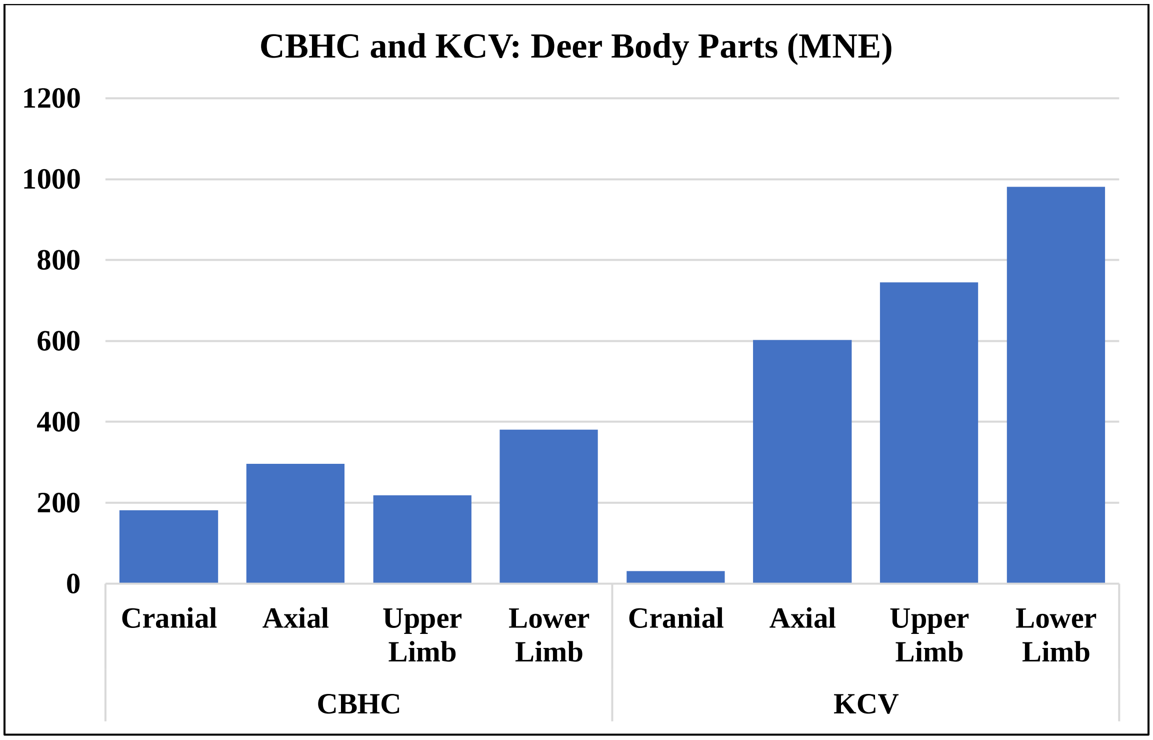

Figure 7.4 CBHC and KCV Deer Body Parts Comparison

These villages were likely occupied at the same time or operated within a close-knit series of moves between generations. Therefore, since it is likely that the villages were occupied simultaneously, these villages likely worked together with regards to resource acquisition, labor investment, defense, and resource management (also see Edwards 2017; Sterner 2018).

There was possibly a series of coordinated hunting strategies and processing could have happened at either site or closer to the proposed agricultural field areas (see Edwards 2017) if there was hunting occurring at the field edges. However, if we view the deer hunting data against the proposed models, site occupants at CBHC were engaged in non-age selective hunting and were hunting locally. Therefore, CBHC site occupants would fall into an OFT strategy of groups under the threat of violence or some type of constraints keeping them closer to home rather than venturing out further for coordinated hunting events and only pursuing the optimal large meat packages (e.g., environmental, social, political).

KCV shows evidence of non-local hunting and an age-selective hunting strategy. This assemblage can be interpreted as a group not under the same constraints as CBHC. Alternatively, the site occupants at KCV may have been processing the deer carcasses in a different area of the site and body parts deposited within this area of the site are primarily from cooking events.

At Washington Irving, there is evidence for a reliance on locally available faunal resources, specifically the upland hunting and wetland resources near the site. (muskrat, fish, deer). The sample of deer elements to be aged does not provide a good indication of selective or non-selective hunting strategies. The deer body parts (MNE) consist of a relatively small sample size, so arguments for local or non-local deer hunting exploits are tentative. However, the deer represented in this assemblage may have been locally hunted along field edges, since there is paleobotanical evidence for a heavy reliance on maize (Emerson et al. 2005; Emerson et al. 2010).

Overall, there appears to be an emphasis on locally available resources exploited and a series of deer hunting strategies that support the criteria for a subsistence strategy that accounts for the threat of violence. While the Fox/Des Plaines data does not meet this expectation as strongly as the Lake Koshkonong villages, this is a possible result of the smaller sample size from Washington Irving.

Optimal resources serve multiple functions (e.g., hides or furs, dense bones for tool manufacture, high-yields of grease or marrow for additional caloric intake).

When examining the species present within the Lake Koshkonong and Fox/Des Plaines there is an emphasis on animals which served multiple purposes (e.g., tools, hides and pelts, raw materials). Both the Wisconsin Oneota and Langford village faunal assemblages show an emphasis on deer and *Cervidae* elements (Figure 7.5).

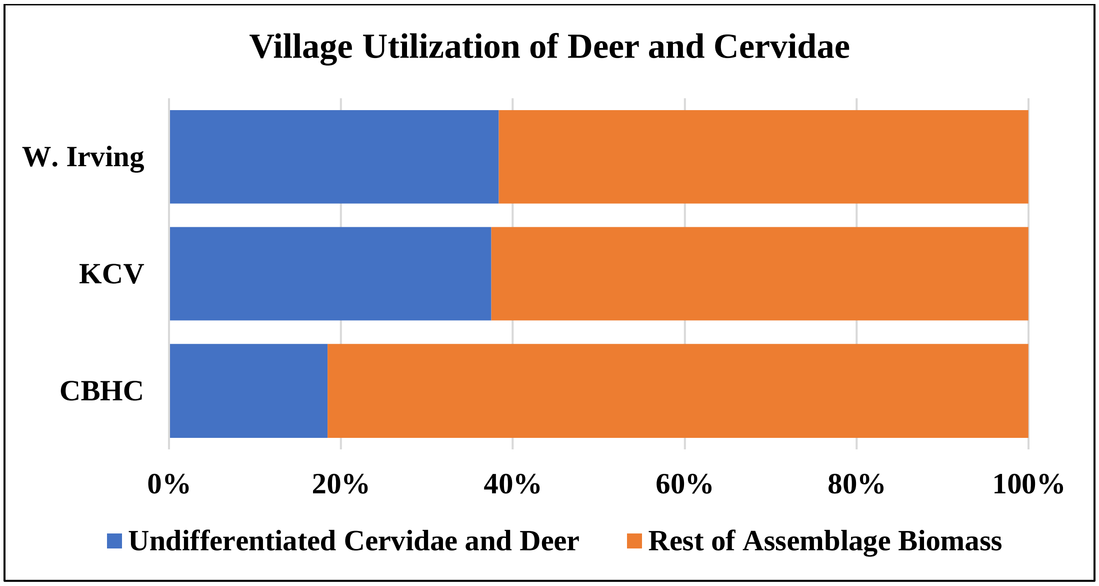

Figure 7.5 Village Comparison of Deer and Cervidae Utilization

These large mammals provided denser bones for tools and hides. *Cervidae* were used in the Lake Koshkonong Locality for agricultural tools (e.g., digging sticks) and both expedient and formal tools, as discussed in Chapter 6. Large mammals also would have provided bone grease and marrow for additional caloric intake. Apart from *Cervidae*, medium mammals such as muskrat and beaver would have provided a medium meat package and pelts.

Within the Lake Koshkonong Locality, there is evidence for the use of bird long bones as beads and undifferentiated tools or items of personal adornment. The use of animals as potential meat packages and raw materials is also seen with the use of Three Ridge mussels as pigment applicators at KCV and the general use of shell as a ceramic tempering agent.

Optimal resources are found where other subsistence or resource acquisition activities occur (e.g., near crop tending, clay resources, chert quarries).

The resource acquisition model data shows that both CBHC and KCV site occupants relied upon animals which would have been captured along water edge areas. When examining all species biomass data, including deer, the data indicates that CBHC site occupants relied more heavily upon water edge species than KCV. This difference in aquatic animal emphasis mirrors the immediate (2km) difference in local environmental niches.

Given the close proximity of Washington Irving to wetlands (Table 7.1 and Figure 7.1), a relatively small amount of the overall species are from water-edge environments (Figure 6.1). However, the overall emphasis of deer at the site obscures the importance of water-edge animal exploitation. After deer, water-edged animals account for the bulk of the Washington Irving assemblage. The fish species present in the assemblage show a variety of different sized species, which were likely captured in a variety of methods (e.g., hook and line, net weir). Different capture methods could have been employed while pursuing other tasks along the wetland areas, such as net weirs left overnight and checked while looking at traps for aquatic mammals like muskrat.

The difference in emphasis on watershed animal resources between Wisconsin Oneota and Langford groups may be connected to the utilization of wild rice and mussel shells. Both the KCV and CBHC sites show a high emphasis on wild rice (Edwards 2017) and mussel shell is a standard tempering agent for Oneota ceramic manufacture (e.g., Hall 1962; Schneider 2015). Since Langford groups do not utilize wild rice or use shell as a tempering agent, they may have simply spent less time already invested along watershed areas. This assertion is supported within the Lake Koshkonong Locality. Edwards (2017) found that there was more wild rice present at CBHC when compared with KCV. KCV is located further from Lake Koshkonong, and therefore the site occupants may have spent more time and labor in agricultural fields. As a result, there may have been less time or energy invested pursuing water-edge game and fishing. Alternatively, there may have been a different labor organizational pattern at KCV compared with CBHC.

Since it is likely CBHC and KCV were occupied simultaneously, an exchange of plants animals based on immediate local proximity may have occurred. In such a case, occupants at CBHC would have invested more time tending and gathering wild rice fields and gathering mussel shells, and thus would have already been in the immediate area to set and check traps along the shores of Lake Koshkonong and to go out fishing.

As such, Langford groups at Washington Irving and Oneota groups at KCV show evidence of spending more time and labor invested in agricultural pursuits (see Edwards 2017; Emerson et al, 2005; Emerson et al. 2010). Therefore, it is unsurprising that there is a higher emphasis on field-edge hunting and trapping at Washington Irving and KCV when compared with CBHC.

Based on the model data sub-sets comparing water-edge, forest, and field-edge, it is likely that there is a commonality between Oneota and Langford groups that they were targeting local resources. As such, the villages in the Lake Koshkonong and Fox/Des Plaines localities fulfill the modified OFT criteria for groups under the threat of systemic violence.

Research Question 2: What is the nature of the relationship between site type and faunal remains in the Lake Koshkonong and Fox/Des Plaines localities?

This dissertation examines the faunal assemblage from three different functional sites, or site areas. Washington Irving, Crescent Bay, and KCV are all year-round occupied village sites. Robinson Reserve is a mortuary camps, and Schmeling, or at least the portion that the faunal assemblage is from, is likely a mortuary precinct for the locality. Because there are no faunal materials from the surface collected site area that contains the possible village portion of the site, the Schmeling assemblage can effectively be considered a non-village. Schmeling is separated on the landscape from CBHC by a natural draw, it is slightly elevated above CBHC and overlooks the lake. Further, there are no structures or evidence of a year-round occupation, or any types of specific occupation-related activities in the excavated portions of the site. The pattern of spatially distinct mortuary areas separated from the residential village, in addition to burials within the village, is also seen at the in other Oneota Localities (e.g., O'Gorman 2001).

Each of these three site types should have distinct assemblages (Styles and Purdue 1991). Villages, where the widest range of activities took place should have dense food refuse, relatively large number of species richness, and a full range of *Cervidae* body parts. Furthermore, while the species richness should be high, the number of atypical and non-local species should be low. Mortuary camps include a more-narrow range of activities, such as mound building, burial/internment, ancestor veneration, and feeding those performing mortuary activities. As such, species richness should be low, food refuse should be intermediate-to-low, and unusual or non-local species should be intermediate. Because much of the food consumed is likely brought to the site, *Cervidae* remains should be from high utility body parts. While burial sites have a very narrow range of activities (e.g., burial, feasting, ancestor veneration), the ideological importance of these activities creates a distinct signature that includes a high species richness, including non-local or atypical species, yet the density of faunal remains should be relatively low. The expectations set forth by Styles and Purdue (1991) are reflected in this dissertation assemblage.

The village sites each meet all of the expectations of habitation sties (see below in Question 3 for a fuller discussion). The Schmeling assemblage has an even species distribution, among a varied range of animals, more so than any year-round village site. The assemblage is also very highly fragmented and shows the highest amount of thermal alteration - specifically calcination within the locality. The species present are the same as those recovered from villages but are not deposited or processed in the same manner. The uselife of these resources and the actual food consumed at the site shows a different series of habitual behaviors than a typical Koshkonong Oneota village. Furthermore, Schmeling has a disproportionately large number of fawns. While the species is not atypical, their age makes them atypical fauna. So, as expected for a cemetery/mortuary site, Schmeling has a relatively high species richness, but its composition is different than the general diet (exemplified by village assemblages). There is a much higher proportion of fish at Schmeling compared with CBHC and KCV (Figure 7.6). Further, the Schmeling site shows a higher emphasis on fawns and yearlings with no evidence of prime-age deer (Figure 7.7). However, it is important to note that the overall assemblage size is smaller than CBHC or KCV.

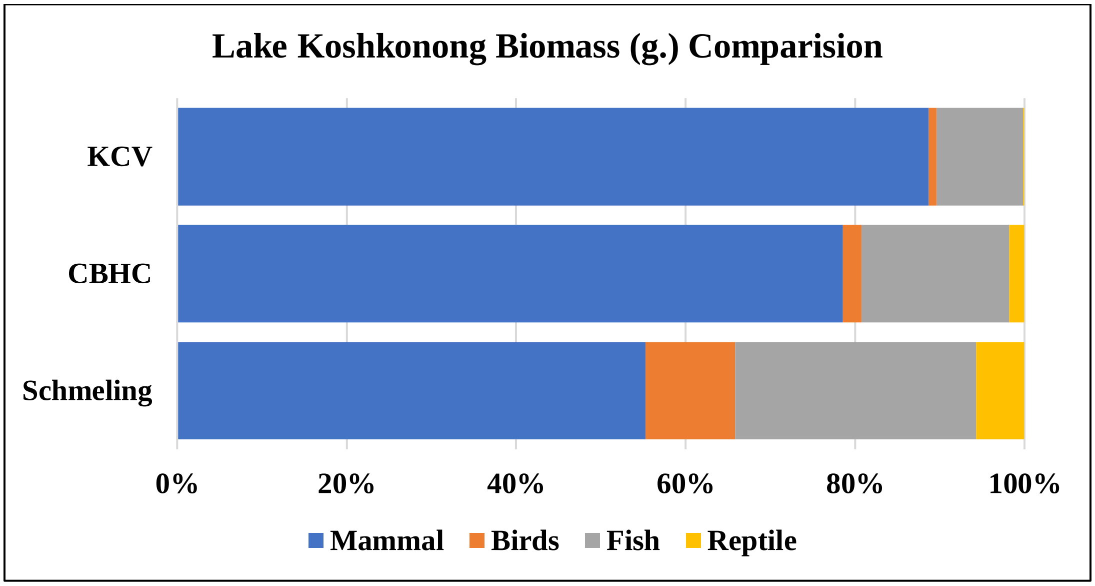

Figure 7.6 Lake Koshkonong Biomass Comparison

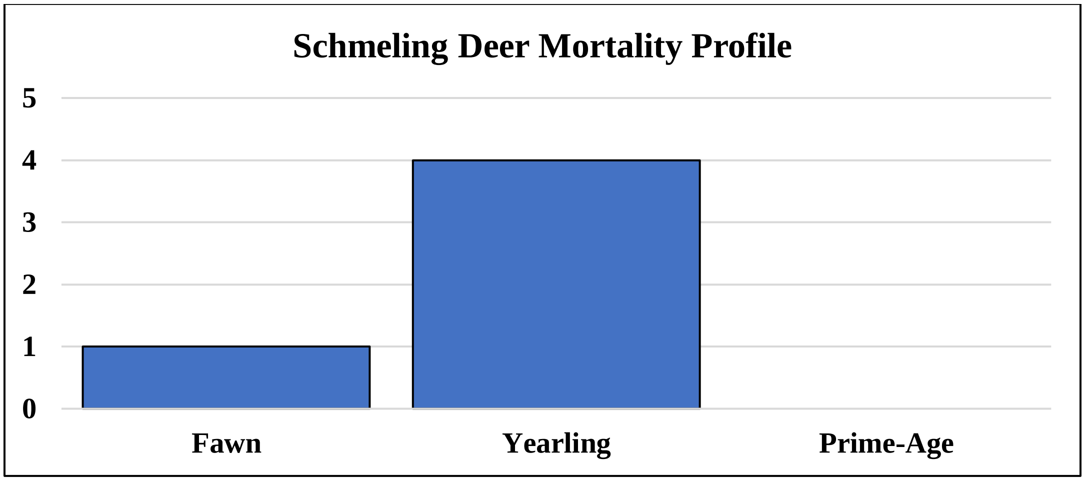

Figure 7.7 Schmeling Assemblage White-Tailed Deer Ages

Evidence suggests that Robinson Reserve was a mortuary encampment and shows an even higher emphasis on white-tailed deer hunting and an extremely limited exploitation of aquatic resources. The fauna at Robinson Reserve is more focused on deer exploitation than Washington Irving. (Figure 7.8) Robinson Reserve is dominated almost exclusively on white-tailed deer and muskrat, which was acquired along the nearby Des Plaines River. Given the small number of species present (18 species, see Chapter 6) and the presence of a mortuary complex at the site, it is possible that these two animals were not just food for the occupants but played a role in mortuary activities as well.

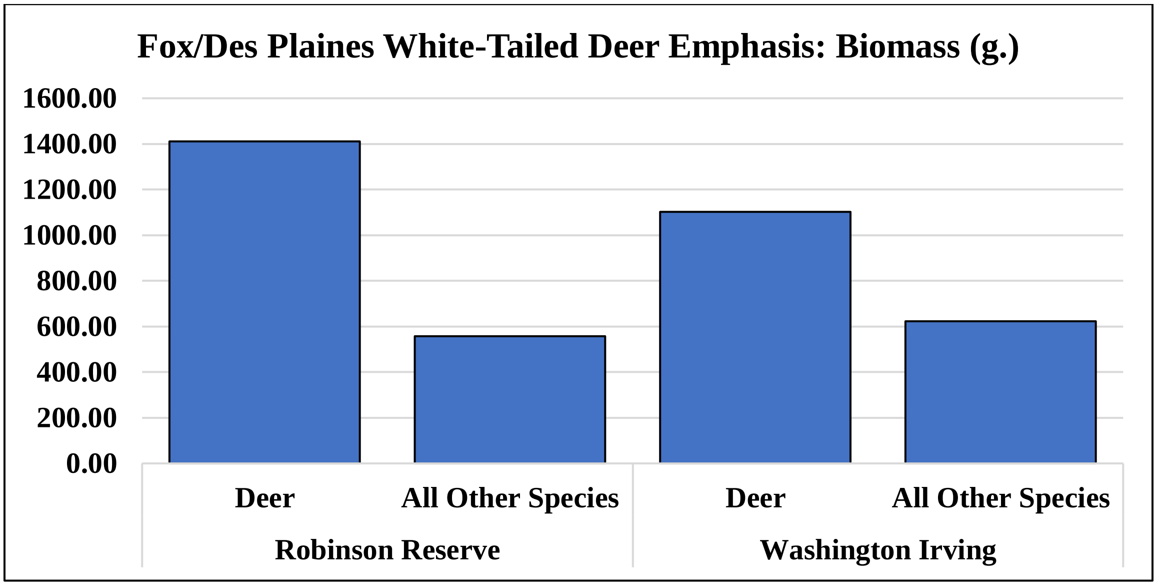

Figure 7.8 Fox/Des Plaines Locality Deer Exploitation

As a mortuary encampment, the site was used for several distinct yet related functions (e.g., mound building, burial/internment, ancestor veneration), as well as feeding those staying at the site for to perform those functions. So, the faunal refuse recovered at Robinson Reserve may be related to multiple activities through time but represent a far narrower range than those at habitation sites (*sensu* Styles and Purdue 1991). Both deer and muskrat are highly represented in the Robinson Reserve assemblage.

Cosmologically, muskrat may have represented an underworld creature, easily captured by trapping along the Des Plaines, and used as a juxtaposition in feasting with the deer- possibly representing the earthly realm (Carr 2008; Fortier 2008; Harper 1999; Holt 1996). At Washington Irving, both muskrat and deer are also present, but the village inhabitants at Washington Irving vertebrate assemblage shows an overall higher emphasis on aquatic resources (e.g., fish, waterfowl) than Robinson Reserve. Fish, of varying sizes and capture techniques, would have easily been caught as supplementary resources to deer hunting. The association of the faunal remains and the burial mounds at Robinson Reserve demonstrates an aspect of the human-animal relationship not seen at the Washington Irving village site.

The same animals are available to the site inhabitants at Robinson Reserve and Washington Irving, however the human choices about which animals to use appear distinct. Given the narrow range of activities and the narrow range of fauna exploited at Robinson Reserve, these are likely connected to mortuary activities (e.g., cosmological ritual, mortuary feasts). In contrast, the wider net of fauna exploited and larger range of activities at Washington Irving shows the same animals (e.g., deer and muskrat) being used in a different manner (e.g., daily subsistence, pelts).

Research Question 3: What is the nature of the human-animal-environmental relationship for Oneota and Langford groups in the Lake Koshkonong and Fox/Des Plaines localities?

When examining the human-animal-environmental relationship for the study sites, subsistence economics, landscape utilization, and cosmological or ritual relationships between humans and animals are discussed.

Lake Koshkonong Subsistence Resources

Based on the biomass calculations for the Lake Koshkonong Locality, no single subsistence strategy could be identified. The year-round village sites, KCV and CBHC, show evidence for an emphasis on large mammals, with fish as a secondary resource. However, at CBHC, the higher emphasis on fishing, reliance on waterfowl, and trapping of medium-sized aquatic mammals reflects their closer proximity to the lake. KCV showed more evidence for white-tailed deer hunting than did CBHC. These intersite differences are further emphasized in their Simpson diversity index scores. The faunal diversity of CBHC and the relative lack of diversity at KCV is mirrored by their exploitation of plants resources (Edwards 2017). CBHC also exploited wild rice to a higher degree than KCV (Edwards 2017). KCV emphasizes reliance on maize agriculture. The animals captured and consumed at these sites reflects the fact that they grew/gathered these plants in different proportions. For example, traps along a field-edge, garden, or lakeshore can be checked at the beginning and ending of these plant-based pursuits. Field-edge hunting would have served the dual purpose of pest-control and obtaining large meat packages that are multi-purpose (e.g., hides, dense bones for tools). Given KCV occupants relied on maize to a greater degree, this would necessitate more fields, thereby increasing access to deer, which is reflected in the zooarchaeological assemblage. At KCV there is a strong emphasis on white-tailed deer. The zooarchaeological data indicates that the bulk of the deer remains are likely the result of field-edge hunting, with some coordinated hunting activities. KCV has a relatively high proportion of fawns and yearlings, meaning they were not necessarily doing most of their hunting during the autumn, when deer are at their largest. The deer mortality profiles are consistent with killing young deer at ages when they would most likely be around agricultural fields, since fawns are often hidden in taller grass or field-edges (Downing and McGinnes 1969; Murphy et al. 1985).

Regardless of intentionality, this pest-management would have served a role in a larger resource sustainability strategy. By targeting deer, regardless of age, alongside fields, the site occupants would obtain larger meat packages locally. These animals would return to field edges on a semi-regular basis. By targeting field-edge deer regardless of maturation, this strategy could exhaust the deer population in the immediate vicinity of the fields, but it would leave the deer whose territory is just beyond the fields to reproduce and repopulate the field-edge territories. So, heavy field-edge hunting could protect agricultural resources while providing a source of protein. If this strategy is emphasized over coordinated hunting events, it would have further served as a method for keeping resource acquisition within a smaller area around the site. Thus, combining protein and plant-based resource management and acquisition within a more secure setting.

At CBHC, the split between white-tailed deer and aquatic resources may indicate a split in labor investment based on season and/or gendered labor. Hunting could have been engaged through both coordinated hunting parties and opportunistic field-edge hunting. The use of fishing and aquatic mammals would have supplemented any opportunistic hunting alongside fields and/or unsuccessful hunting trips (Broughton 2002; Hofman, and Todd 2001; Sanger 1996).

Other activities could be coupled with resource acquisition. Oneota groups needed to exploit local mussel shell beds on a regular basis to obtain ceramic tempering (Benn 1989; Gibbon 1972; Schneider 2015; Stoltman 1991). This systematic need for shellfish means the occupants at CBHC and KCV needed to spend time along the lake and creek. Activities, performed by multiple groups that likely were divided by gender, age, or status could have gone together and performed these subsistence-based activities alongside one another (Erlandson

1988; Moss 1993). One group may have been gathering shellfish and checking lake or creekside traps, while another gathered wild rice in canoes. In this scenario, both groups have the safety, not only in their own numbers, but that of the adjacent group as well. Furthermore, they can take full advantage of the surrounding terrain to watch for potentially approaching enemies. Additionally, these multi-group activities within a single resource patch would be an efficient exploitation strategy. In these cases, both energetic efficiency and physical safety could be maximized. Further, a sense of cooperation and cultural maintenance, group cognizance, and identity could be reinforced through these shared, collaborative activities (Brown 1985; Duhaime et al. 2004; Thomas 2007; Zeder 2012).

Ethnoarchaeological accounts of shellfishing and fishing activities support this assertion. They have shown that such activities are often done alongside each other by distinct age and gendered cohorts (Bird and Bliege Bird 1997, 2000; Thomas 2007). Children are then trained in these subsistence activities and carefully watched by multiple adults. Criteria for resource acquisition – which resources to exploit, individual animals and/or plants to leave for maturation or culinary or cultural preference are learned, reinforced, and form the basis of community habitus (Bird and Bliege Bird 1997, 2000).

The human-animal-environmental relationship evidenced at Schmeling is the result of a difference in site function. CBHC is the physically the closest village to Schmeling, and based on radio-carbon assay overlap, it is likely those buried at Schmeling were in some manner related to the people occupying the villages in the locality (Edwards 2010; Schneider 2015; Sterner 2018). The animal resources recovered from Schmeling show a pattern for a higher emphasis on fishing and aquatic animals, with a relatively low exploitation of white-tailed deer. This distinction is key for understanding the human-animal resource exploitation and connection within the larger multi-faceted locality.

Fox/Des Plaines Subsistence Resources

While the examination of the biomass calculations for the Fox/Des Plaines Locality identified some similarities between the two assemblages, the overall patterns were distinct. Most of the differences can be attributed to site function (see above). Washington Irving is a year-round village site that, like most Langford sites, shows a strong emphasis on white-tailed deer hunting with a limited exploitation of local aquatic fauna.

Unlike Oneota groups in the region, Langford groups do not show evidence of exploiting Eastern Agricultural Complex (EAC) plants (Edwards 2017; Edwards and Jeske 2017; Emerson 1999; Emerson et al. 2005, 2010; Jeske 1989, 2000, 2002). Further, Langford groups typically show a higher emphasis on upland game hunting than Oneota groups (Emerson 1999; Emerson et al. 2010; Jeske 1989, 2000, 2002; Martin 1996; Pennman 2010; Yerkes 1987). The larger emphasis on maize agriculture for Langford groups may also reflect a similar strategy as hypothesized for the Koshkonong Oneota. Hunting activities at Washington Irving probably occurred along field-edges. However, due to the lack of evidence for a variety of secondary protein resources, it is unlikely that opportunistic field-edge hunting and trapping was the only or even the main method of deer acquisition. It could be that there was a strategy of less protein intake as part of the regular dietary strategy, or there was a higher amount of coordinated hunting ventures. It is probable the local deer populations would have been taxed to a higher degree. By over hunting local deer, Langford hunting parties would have been forced to travel increasing distances from the site. Consequently, a portion of the population would have been more regularly exposed to the risk of violence from neighboring and possibly hostile groups.

Ritual/Cosmological Connections

There is a distinction in both cultural groups between the landscape for the living and proximity to the deceased. This connection between humans and their environment is both cosmological and physical. This relationship is significant in relation to the differential treatment of site criteria beyond an economic or defense-related pursuit.

Langford groups within the Fox/Des Plaines physically separated the landscape and surfaces between the living and the deceased. Washington Irving, while a village site that was occupied or re-occupied through multiple generations, did not yield any human remains or suspected burial features. In contrast, Robinson Reserve and Wildrose Mounds contain burial mounds which included inhumations (Foley 2011; Lurie 1992). This separation of the deceased completely from village life within this locality is not a universal characteristic of Langford groups (e.g., Material Service Quarry).

At Robinson Reserve, while there is a physical connection between the living and deceased documented on the landscape in the form of landscape modification, this connection is also demonstrated by the faunal record. Mortuary activities involving food consumption are likely present at the site. The site occupants at Washington Irving or another Langford site may have visited or re-visited the burial mounds at Robinson Reserve, consumed food, and then deposited the faunal remains within the site area between and around the mounds. The mounds could have simultaneously served as a marker of Langford territory, previous Langford occupations within the area, and/or were visited by contemporary or later Langford populations. The burial mounds likely served as a physical embodiment of mortuary activities. Langford groups returning to the site through time may have come for communal mortuary events. Alternatively, the food refuse deposited at the site consisted of mortuary activities associated with the internment of individuals within the mounds. Fundamentally, the social memory inscribed on the landscape, personified by the mounds, would have been visible for multiple generations. Feasts or meals consumed during mound construction possibly echoed village life but within a mortuary context had a separate meaning or cognitive significance. This connection between food, the mortuary interment, and landscape modification is a complex issue, but significant for the study of Langford human-animal-environmental relationships. There is some evidence for communal cooking activities between the mounds at Robinson Reserve, but little such evidence at Washington Irving.

A different pattern is observed in the Lake Koshkonong Locality. The separation of the living and the deceased is nonuniform within the Locality. There is no consistent pattern of separation or single form of burial within a single site. The connection between the living and dead is not necessarily able to be separated easily from village structure and domestic life. For the Oneota groups at CBHC and KCV, the deposits relating to the living and dead are literally intertwined with the village structure, a common trait among Wisconsin Oneota villages (see Foley 2011; O’Gorman 2001; Sterner and Jeske 2018). This intertwined nature can be seen with human remains buried within longhouses, and isolated human remains found in refuse pits. However, separation can be seen at Lake Koshkonong with the physical separation of CBHC and Schmeling. This pattern of non-uniform burial programs is not unusual for Late Prehistoric groups in the region (e.g., Charles 1992; Emerson and Hargrave 2000; Foley 2012; Goldstein and Richards 1991; Jeske 2015; Milner et al. 1991; O’Gorman 2001). But this pattern is different than the human-environmental relationship established for living and dead in the Fox/Des Plaines Locality. The closer entanglement of Wisconsin Oneota villages, rather than the physical separation of Langford villages is possibly due to the following:

1) Oneota groups occupied one particular and smaller territory on the landscape with more intention of marking their permanence of place in the cultural and/or tribal manner using their dead
2) Oneota groups within the longer-occupied area changed their methods of burial over generations- thus a variety of depositional patterns within the locality
3) Oneota groups had different mortuary burial activities and/or burial perspectives/programs based on status, identity (e.g., clan), or role within the community of the individuals being buried as perceived by the larger village community.

There is also a distinction within the Lake Koshkonong Locality in relation to ritual animal deposits at CBHC. These deposits may mark ritual and/or communal spaces or are the deposited result of various ritual activities. There is a difference in how animal symbolism and cosmology, and the physical manifestation of a spiritual connection between humans and their animals and the landscape, between Oneota and Langford groups. At CBHC, we see clear deposits of entire (e.g., dog burial, eagle burial, etc.) or partial animals (e.g., deer scapula in place of a human scapula in B12-01) with cosmological significance. At CBHC, the literal connection between animals and human burials is established with the inhumation with deer element replacements at CBHC.

The connection between humans and animals in ritual contexts for Langford groups in the Fox/Des Plaines locality is found in consumption patterns when comparing Washington Irving and Robinson Reserve. The larger variety of activities that occurred at the Washington Irving village site can obscure some of the non-economic aspects of the human-animal relationship. The differences in site function and activities related to the living and the dead allow us to make better inferences about the nature of human-animal relationships with regards to economic and non-economic activities. There were almost certainly ritual or non-economic uses for animals at Washington Irving, but this village site does not have evidence for a clear distinction of economic and non-economic deposits. It may be that the site inhabitants at CBHC and Washington Irving invested their time differently in how they interacted with their economic and non-strictly economic animal interactions. Alternatively, Langford groups may have simply had different concepts that resulted in the blurring of economic and ritual utility of animals when compared to Lake Koshkonong Oneota groups.

The blurring of economic and ritual utility of animals is seen in both the Oneota and Langford localities. Robinson Reserve has a higher emphasis on muskrat and deer, while Schmeling shows a selection of very young white-tailed deer. Both deer and muskrat were present in village assemblages, but it is the focus on particular animals, the age range of deer, and the context in which these animals were consumed and deposited (i.e., mortuary areas) that differentiate the economic utility of protein consumption with the potentially ritual or non-economic activities occurring in association of the consumption.

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1990 Open Field, Common Pot: Harvest Variability and Risk Avoidance in Agricultural and Foraging Societies. In *Risk and Uncertainty in Tribal and Peasant Economies*, edited by E. Cashden, pp. 67-88. Westview Press, Boulder.

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Winterhalder, Bruce and Carol Goland
1997 An Evolutionary Ecology Perspective on Diet Choice, Risk, and Plant Domestication. In *People, Plants, and Landscapes: Studies in Paleoethnobotany*, edited by K. J. Gremillion, pp. 123-160. The University of Alabama Press, Tuscaloosa.

Winterhalder, Bruce and Douglas J. Kennett

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Wisconsin Department of Natural Resources
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Wisconsin Historical Society
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2010 Methodological Issues in Paleoethnobotany: A Consideration of Issues Methods and Cases. In *Integrating Zooarchaeology and Paleoethnobotany: A Consideration of Issues Methods and Cases*, edited by A. M. VanDerwarker and T. M. Peres, pp. 37-64. Springer, New York.

Wylie, Alison
1989 Archaeological Cables and Tacking: The Implications of Practicefor Berstein's 'Options Beyond Objectivism and Relativism'. Philosophy of the Social Sciences 19:1-18.

2000 Questions of Evidence, Legitmacy, and the (Dis)Unity of Science. American Antiquity 65:227-237.

Young, Biloine Whiting and Melvin L. Fowler
2000 *Cahokia: The Great Native American Metropolis*. University of Illinois Press, Urbana.

Zedeño, María Nieves
1997 Landscapes, land use, and the history of territory formation: An example from the Puebloan Southwest. *Journal of Archaeological Method and Theory* 4(1).

Zedeño, María Nieves, Diane Austin, and Richard Stoffle
1997 Landmark and landscape: A contextual approach to the management of American Indian resources. *Culture & Agriculture* 19(3): 123-129.

Zolberg, Aristide R.
1992 Labour migration and international economic regimes: Bretton Woods and after. Pp: 315-34.

Curriculum Vita

Rachel C. McTavish, M.S.
Curriculum Vitae
April 2018

Education

2013- 2019	PhD Anthropology, University of Wisconsin-Milwaukee Concentration in Archaeology
2010-2013	M.S. Anthropology, University of Wisconsin-Milwaukee Thesis: *Faunal Subsistence Strategies Among Initial Period Coastal Fishers at the Gramalote Site in the Moche Valley of Peru*
2006- 2010	B.A. Anthropology, Theatre Arts (Dance), Beloit College, Cum Laude

Academic Scholarships, Grants, and Awards

2017	UWM Anthropology Student Union Travel Grant
2016	Ruth Cohen Memorial Fellowship
2013	UWM Faculty and Student Teaching Assessment Award
2012-2013	UWM Graduate School Student Travel Grant
2012-2014	Anthropology Student Union Conference Travel Grants
2011	UWM Center for Latin American and Caribbean Studies Graduate Student Travel Grant
2006-2010	Beloit College Eaton Scholarship

Professional Experience

Teaching Experience

2016-Present	Adjunct Professor, College of Lake County Anthropology 121: Introduction to Anthropology (4-Field) Anthropology 221: Introduction to Cultural Anthropology
2017	Adjunct Professor, Carroll University CCS 100: Anthropology of Death
2017	Maternity Leave Visiting Professor, Beloit College Anthropology 218: Environmental Archaeology Anthropology 120: The Human Animal
2016	Adjunct Professor, Carroll University CCS 100: Anthropology of Death
2016	Adjunct Professor, Beloit College Anthropology 110: Introduction to Archaeology and Prehistory

2015	Adjunct Professor, Ripon College Anthropology 221: Human Origins
2014-2015	Teaching Assistant, University of Wisconsin-Milwaukee Anthropology Department Anthropology 501: Archaeology of Death Anthropology 525, Zooarchaeology: Analysis of Faunal Remains Anthropology 281: Deadmen Do Tell Tales Anthropology 431: Criminalistics
2011-2014	Laboratory Instructor, University of Wisconsin-Milwaukee Biological Sciences Department Biological Sciences 202: Anatomy and Physiology I
2008	Teaching Assistantship, Beloit College: Anthropology 110: Archaeology and Prehistory

Laboratory Experience

2017-2018	Faunal Analysis, Lake Farms Archaeological District, Wisconsin, Jennifer Haas
2016-2017	Faunal and Lithic Resource Economization Project, Washington Irving Site, Programs in Midwest Archaeology (PIMA)
2016	Faunal Analysis, McHugh Historic Farmstead Site, UWM CRM Mitigation Survey, Jennifer Picard and John Richards
2015	Faunal Identification, Port Washington Historic Lighthouse Project, Port Washington Historical Society, Sarah Smith
2015	Faunal Identification, Carcajou Point Site (47JE002)- Middle Woodland Component, Wisconsin Historical Society Mitigation Survey, John Broihahn and Amy Rosebrough
2015	Programs in Midwest Archaeology (PIMA) Faunal Analysis Volunteer Coordinator, Supervise and train of undergraduate and graduate student volunteers, Robert Jeske
2013-2015	Faunal Analysis of Koshkonong Oneota Sites: Crescent Bay Hunt Club (47JE904), Koshkonong Creek Village (47JE379), Schmeling (47JE833), Robert Jeske
2012-2014	Faunal Analysis, Aztalan Site (47JE001) 2011-2013 UW-Milwaukee excavations, John Richards
2013-2014	Visiting Researcher at The Milwaukee Public Museum, Analysis of Aztalan Princess Burial Beads, under supervision of Dawn Scher-Thomae
2012	Zooarchaeology Laboratory Assistant under supervision of Jean Hudson

2011	Faunal Identification, Gramalote Site and Cerro La Virgin Site, Huanchaco, Peru for Jean Hudson
2009	NAGPRA Repatriation and Reburial Preparation Assistant, Gila Cliff Dwellings National Monument- National Park Service and National Forest Service, under supervision of Rebecca Latanick

Field Experience

2015-Present	Archaeology Technician (Phase I, II surveys and monitoring), Brian Nicholls, University of Wisconsin-Milwaukee Cultural Resource Management
2014	Archaeology Technician (Phase I surveys) Kathryn Egan-Bruhy, Commonwealth Cultural Resource Group
2013	Milwaukee County Institution Grounds, cemetery excavation crew member, under supervision of Dr. Patricia Richards, Historic Research Management Services
2011-2012	Archaeology Technician (Phase I and Phase II surveys), Brian Nicholls, Historic Research Management Services 2011
2011	Pabst Farms Phase III excavation project crewmember, Brian Nicholls, Historic Research Management Services
2009	National Park Service Gilla Cliff Dwellings National Monument; archaeological fieldwork and museum work- supervised by Rebecca Latanick, Chief of Interpretation for the Gilla Cliff Dwellings National Monument

Volunteer Experience

2014-2016	UW-Milwaukee Women's Center volunteer
2012-2014	Excavation at Koshkonong Creek Village and Crescent Bay Hunt Club Sites: Oneota site habitation and burial contexts, Robert Jeske
2008	Summer Peru/Chile Field School, under supervision of Dan Shea and Mario Rivera
2008	South American Field School Preparation for Dan Shea

Public Outreach

2015	Milwaukee Public Museum In and Out of Collections Event: *Shell from the Aztalan Site (47JE001) MPM Collections*
2015	Milwaukee Public Museum Archaeology Fair: *Using Prehistoric Technology*, with Katherine Sterner-Miller
2014	University of Wisconsin-Milwaukee Archaeology Field School Open House volunteer artifact interpretation

2014 Milwaukee Public Museum Archaeology Fair: *Desired Objects of the Sea: Shell and Pearls in Archaeology*

2013 Milwaukee Public Museum Archaeology Fair: *We are What We Eat: Plants and Animals in Archaeology*, with Jennifer Picard

2011 Chippewa Falls High School Career Fair: *Archaeology in Practice*

<u>Presentations at Professional Meetings</u>

McTavish, Rachel C.

2018 Freshwater Mussel Shellfishing as Evidence of Cultural Continuity and Divergence During the Late Prehistoric in Wisconsin. Paper presented at the 110th National Shellfisheries Association Annual Meeting, Seattle Washington

McTavish, Rachel C.

2017 Investigating Cultural Identity and Assimilation Through Foodways: A Case Study from the McHugh Site. Paper presented at the Midcontinental Archaeology Conference, Indianapolis, Indiana.

Greiff, AmySue, Drew Agnew, Rick Edwards, Rachel C. McTavish

2017 Fauna For Thought: Preliminary Comparative Analysis of Oneota Faunal Refuse Among Different House Structures

McTavish, Rachel C.

2017 Shellfishing as Evidence for Cultural Continuity and Divergence during the Late Prehistoric In Wisconsin: A Comparative Study of Mussel Shell Use at Two Oneota Localities. Paper presented at the 4th Independent Meeting of the ICAZ Archaeomalacology Working Group (AMWG). Kirkwall, Orkney.

McTavish, Rachel C.

2016 Viewshed Analyses for the Oneota Lake Koshkonong Locality: Defensibility as a Critical Variable in Settlement Studies. Paper presented at the Midcontinental Archaeology Conference, Iowa City, Iowa.

Robert J. Jeske, Seth A. Schneider, Richard W. Edwards, Katherine Sterner, and Rachel C. McTavish

2016 Strangers in a Strange Land: The Lake Koshkonong Oneota Locality in Context. Paper presented at the Midcontinental Archaeology Conference, Iowa City, Iowa.

Rachel C. McTavish and Amy Klemmer

2016 Bone, Horn, and Antler Technologies: A Worked Fauna Analysis from Oneota Sites in the Lake Koshkonong Locality. Poster presented at the Midcontinental Archaeology Conference, Iowa City, Iowa.

Agnew, Drew, AmySue Greiff,, Rachel C. McTavish and Amy Klemmer

2016 Investigations of Risk Management and Cultural Continuity: Oneota Faunal Patterns in the Lake Koshkonong Locality. Paper presented at the Midcontinental Archaeology Conference, Iowa City, Iowa.

McTavish, Rachel C. and Corey Hoover

2016 A Holistic Investigation of Economization at a Late Prehistoric Village in Northern Illinois. Paper presented at the 82nd Annual Meeting for the Society of American Archaeology, Vancouver, Canada

McTavish, Rachel C., Lucienne Van de Pas and Amy Klemmer

2015 Economics, Culture, and Ecology: A Comparative Study of Oneota Localities in Wisconsin. Paper presented at the 81st Annual Meeting for the Society of American Archaeology, Orlando, Florida

Van de Pas, Lucienne Van de Pas, Rachel McTavish, and Amy Klemmer

2015 The Role of Animals in Oneota Subsistence and Agricultural Technology: A Case Study from the Lake Koshkonong Locality. Paper presented at the Midcontinental Archaeology Conference. Milwaukee, Wisconsin

McTavish, Rachel C.

2015 Life and Stress at a Langford Village Site, A Zooarchaeological Case Study at the Robinson Reserve Site (11CK2). Paper presented at the Midcontinental Archaeology Conference. Milwaukee, Wisconsin

McTavish, Rachel C.

2015 Examining the Dynamic Relationship of Langford Groups on the Landscape. Paper presented at the Midcontinental Archaeology Conference. Milwaukee, Wisconsin

Picard, Jennifer L. and Rachel C. McTavish

2015 Ecology, Culture, Conflict and Diet: Comparisons of Two Late Prehistoric Sites in Southeastern Wisconsin. Paper presented at the 80th Annual Meeting of the Society of American Archaeology, San Francisco, California.

McTavish, Rachel C. and Elissa B. Hulit

2014 An Examination of the "Princess Burial" Beads collection at the Milwaukee Public Museum. Paper presented at the 60th Annual Midwest Archaeology Conference, Champagne, Illinois

McTavish, Rachel C. and Richard W. Edwards IV

2014 An Analysis of Variation in Oneota Watershed Exploitation in the Lake Koshkonong Locality. Paper presented at the 60th Annual Midwest Archaeology Conference, Champagne, Illinois

McTavish, Rachel C.

2014 Upper Mississippian Large Mammal Butchering Practices: A Case Study from Langford Sites in Northern Illinois. Paper presented at the 79th Annual Meeting of the Society of American Archaeology, Austin, Texas

McTavish, Rachel C.

2013 Preliminary Mussel Shell Analysis of the Crescent Bay Hunt Club Site (47JE904). Paper presented at the 59th Annual Midwest Archaeology Conference, Columbus, Ohio

McTavish, Rachel C.

2013 Evaluating the Aztalan Palimpsest: Faunal Analysis of a Potentially Mixed Late Woodland and Middle Mississippian Context. Paper presented at the 78th Annual Meeting of Society of American Archaeology, Honolulu, Hawaii

McTavish, Rachel C.

2013 Fishing for Ideas: Discussions of Coastal Peruvian Subsistence with Dan Shea. Paper presented at the 41st Annual Midwest Conference on Andean and Amazonian Archaeology and Ethnohistory, Invited Symposium in Honor of Daniel Shea, Chicago, Illinois

McTavish, Rachel C.

2012 White-tail Deer Butchering Practices at the Aztalan Site (47JE0001). Paper presented at the 58th Annual Midwest Archaeology Conference, East Lansing, Michigan.

Edwards, Richards W. IV and Rachel C. McTavish

2012 A Tail of Two Fishes: Oneota Fish Exploitation at the Koshkonong Creek Village Site (47JE379) and the Crescent Bay Hunt Club (47JE904) Paper presented at the 58th Annual Midwest Archaeology Conference, East Lansing, Michigan, Invited Symposium on Koshkonong Regional Archaeology

McTavish, Rachel, Jean Hudson, Roberta Boczkiewicz, Jesús Briceño Rosario and Brian Billman

2012 Chronological Patterns in Vertebrate Taxa at Gramalote, Peru. Poster presented at the 40th Annual Midwest Conference on Andean and Amazonian Archaeology and Ethnohistory, Chicago, Illinois

Boczkiewicz, Roberta, Jean Hudson, Rachel McTavish, Jesús Briceño Rosario and Brian Billman

2012 Fish Utilization at Gramalote, Peru. Poster presented at the 40th Annual Midwest Conference on Andean and Amazonian Archaeology and Ethnohistory, Chicago, Illinois

Hudson, Jean, Roberta Boczkiewicz, Rachel McTavish, Jesús Briceño Rosario and Brian Billman

2012 Faunal Remains from Gramalote, Peru: Contexts and Overview. Poster presented at the 40th Annual Midwest Conference on Andean and Amazonian Archaeology and Ethnohistory, Chicago, Illinois

Presentations at Anthropology Professional Development Workshops

McTavish, Rachel C.

2015 A Preliminary Analysis on the Role of Animals in Late Prehistoric Jefferson County, Wisconsin. Paper presented at the University of Wisconsin-Milwaukee Anthropology Student Union Colloquium.

McTavish, Rachel C.

2013 Preliminary Mussel Shell Analysis of the Crescent Bay Hunt Club Site (47JE904) and broader implications for the Midwest. Paper presented at the University of Wisconsin-Milwaukee Anthropology Graduate Student Workshop

McTavish, Rachel C.
2012 Coastal Peruvian Subsistence, a Discussion of Rapid or Gradual Changes through Time. Paper presented at the University of Wisconsin-Milwaukee Anthropology Graduate Student Workshop

McTavish, Rachel C.
2011 Studying Patterns of Faunal Use through Time at the Gramalote Site in Northern Peru. Paper presented at the University of Wisconsin-Milwaukee, Anthropology Student Union Colloquium

McTavish, Rachel C.
2010 Water Symbolism and Monumental Architecture: Reinforcing the Hierarchical Power of the Mayan Elites. Paper presented at the Beloit College Spring Student Symposium

McTavish, Rachel C.
2008 Preservation of the Atacama Desert as seen in shell mounds in Camarones, Chile. Paper presented at the Beloit College International Student Symposium

Presentations at Pedagogy Professional Development Workshops

McTavish, Rachel C. and Andrew J. Petto
2014 Diagnostic Teaching in the Anatomy Labs. Workshop presentation at the UW Systems Office of Professional and Instructional Development Spring Conference, Green Lake, Wisconsin

McTavish, Rachel C. and Andrew J. Petto
2013 Diagnostic Teaching Assessments for Teaching in the Sciences, Workshop presentation in the 2013 Center for Instructional and Professional Development: Assessment Showcase Winners Workshop, University of Wisconsin-Milwaukee

McTavish, Rachel C. and Andrew J. Petto
2013 Diagnostic Teaching as Formative Assessment, Revised poster presented at the 27th Annual Meeting of the Society of Human Anatomy and Physiology, Las Vegas, Nevada

McTavish, Rachel C. and Andrew J. Petto
2013 Diagnostic Teaching as Formative Assessment, Poster presented at the First Annual Faculty Assessment Showcase, University of Wisconsin- Milwaukee

Research Reports

In Progress *Report of Excavations and Resulting Analysis of the Schmeling Site (47JE833), Fauna section*, Rachel C. McTavish, senior author Robert Jeske

In Progress	*Technical Report for the The Aztalan Site (47JE001) 2011 and 2013 Advanced Field School, Fauna Chapter*, Rachel C. McTavish, edited by John Richards
In Progress	*Diagnostic Teaching as Formative Assessment for Teaching in the Sciences*, Rachel C. McTavish and Andrew J. Petto
In Progress	*Diagnostic Teaching as a "Refraction" Pedagogy as used in Histology Instruction*, Rachel C. McTavish and Andrew J. Petto

Research Interests

Zooarchaeology, Midwestern archaeology, late prehistory, stress-adaptation, subsistence practices, environmental archaeology, ethnoarchaeology, experimental archaeology, food-sharing practices, comparative anatomy, taphonomy, stable-isotope applications, diagnostic pedagogy

Professional Certifications

Wisconsin Historical Society Archaeologist Qualified to Excavate Human Remains

Professional Service

2014-2016	Wisconsin Archaeological Society ad-hoc Bylaws committee member
2014-2016	Wisconsin Archaeological Society Programming and Publicity co-chair
2014-2016	Co-Organizer of Wisconsin Archaeological Society Lecture Series in Milwaukee
2011-2013	Anthropology Student Union: Faculty Representative, University of Wisconsin-Milwaukee

Professional/Educational Affiliations

Midcontinental Archaeology Society
Wisconsin Archaeological Survey
Wisconsin Archaeology Society
Society for American Archaeology
International Council of Archaeozologia (ICAZ)
    ICAZ Archaeomalacology Working Group

Special Skills and Training

Proficient in Geographic Information Systems (ArcGIS)
Zooarchaeological Identifications:
    Mammal, Avian, Fish, Amphibian, and Reptile
    Peruvian Coast and Midwestern United States
Invertebrate identification
    Midwestern United States
Human Burial Excavation training/experience
Microsoft Office (Word, PowerPoint, Access, and Excel)

Relevant Coursework

Zooarchaeology- Faunal Remains
Spatial Statistical Analysis using ArcGIS
Archaeological Mapping
Archaeological Analysis, Report Preparation
Seminar in Ethnoarchaeology
Archaeology of Historic Cemeteries
Anthropological Statistics
Archaeology of Death
Seminar in Lithic Technology

References

Robert Jeske, PhD
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Scott Palumbo, Ph.D.
Associate Professor, Department of
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Jennifer Esperanza, PhD
Associate Professor, Department of
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Jean Hudson, PhD
Associate Professor of Anthropology,
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