A PALEOENVIRONMENTAL RECONSTRUCTION AND ANALYSIS OF FAUNAL UTILIZATION AT THE SAUER RESORT SITE, WINNEBAGO COUNTY, WISCONSIN

By

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TO MY WIFE DEBI

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ABSTRACT

A PALEOENVIRONMENTAL RECONSTRUCTION AND ANALYSIS OF FAUNAL UTILIZATION AT THE SAUER RESORT SITE, WINNEBAGO COUNTY, WISCONSIN

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This study examines the subsistence practices of peoples inhabiting the Sauer Resort site, a Lake Winnebago phase Oneota site in Wisconsin. Two synthetic models of Oneota subsistence practices in Wisconsin are evaluated as they relate to the analysis of the Sauer Resort site faunal assemblage. Paleoenvironmental reconstruction of the surrounding area is accomplished using geomorphological, historical and biological information to determine potential resource zones available for exploitation by the prehistoric populations inhabiting the site. Analysis of faunal remains reveals that a variety of animal species were exploited from spring through the fall. Based upon the faunal findings and ethnohistorical accounts, it is argued that animals at the Sauer Resort site are best viewed as a supplement to maize horticulture. The analysis ultimately leads to refinement of the original models proposed for the subsistence practices of Oneota populations in Wisconsin.

CHAPTER I

INTRODUCTION

In the past 80 years, archaeologists working in Wisconsin and elsewhere have described the subsistence and settlement systems of the Oneota phases of the Upper Great Lakes (Figure 1) (Lawson 1902, McKern 1945, Cleland 1966, 1976, Peske 1966, 1971, Gibbon 1969, 1972, Overstreet 1978, 1981). Utilizing ethnographic and archaeological evidence, Cleland (1966) and Overstreet (1978, 1981) have presented drastically different, synthetic models of the subsistence and settlement systems of these late prehistoric populations. A third model has been proposed by Gibbon (1969, 1972) which despite differences with Overstreet's model, is largely an amplification of the principles suggested by Cleland (1966). The synthetic models described by Cleland (1966) and Overstreet (1978, 1982) provide the problem orientation of this thesis.

In 1966, Cleland, relying upon zooarchaeological and ethnographic data, proposed a model of the subsistence and settlement practices of the five Oneota phases of Wisconsin. Using faunal data from Lasley's Point (Peske 1966), Carcajou Point (Hall 1962), Mero (Mason 1966), and Cahokia (Adams n.d.) as well as ethnographic information from historical groups such as the Ojibwa and Ottawa, Cleland (1966:97) proposed an adaptive system based on the ecological dissimilarity and economic orientation of these five cultural phases. According to Cleland (1966:97), differing ecological conditions (different microenvironments) and the degree of utilization of these environments are found in the various

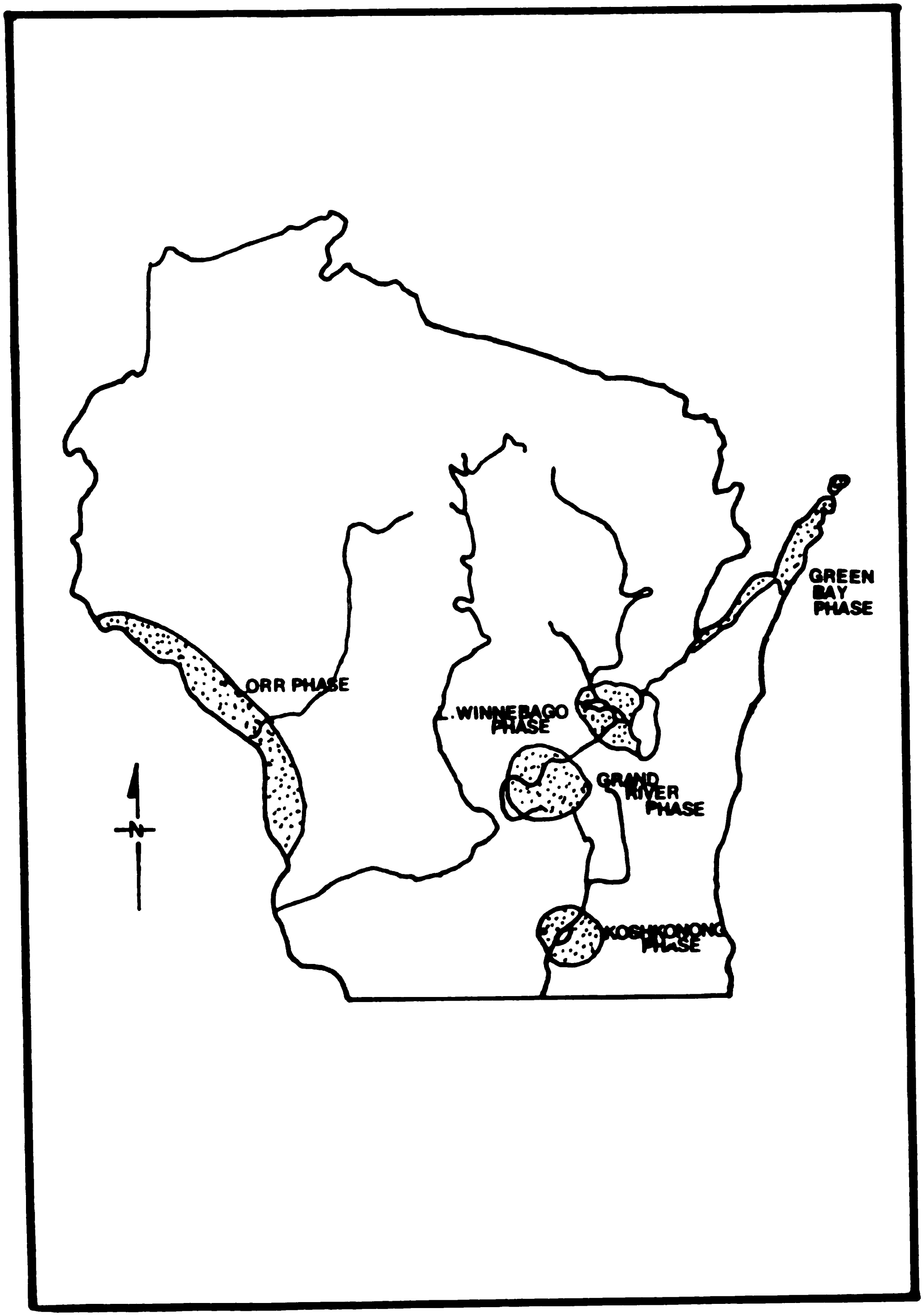

Figure 1 The Five Oneota Phases of Wisconsin

Oneota phases apparent during the late prehistoric period in Wisconsin.

Cleland, following the ecological principles of Odum (1953), described various ecotones found in association with these phases, which are suitable for prehistoric exploitation. Ecotones, according to Cleland (1966) and Odum (1953), are areas where two or more microenvironments converge, thus allowing plants and animals to be found in a transitional area between these two zones. These tension zones, Cleland argues, are areas of higher plant and animal densities, which provide preferential areas for prehistoric exploitation. Based on these principles, Cleland (1966:87) described the microenvironments and ecotones particular to the various Oneota phases.

Cleland's (1966) analysis of the paleoecology and ethnozoology of the Upper Great Lakes is not based solely on Upper Mississippian populations, but is much farther reaching. Analysis of various temporal and cultural periods has led him to propose two types of economic orientations for prehistoric populations of the Upper Great Lakes. Within this seminal work (Cleland 1966), he described the difference between focal and diffuse economies. These ideas were further elaborated in a later paper (Cleland 1976). It is valuable to reiterate the characteristics which denote these different economic orientations.

Certain assumptions, according to Cleland (1976), must be understood when discussing the Focal-Diffuse concept. He states,

> "Although we must be concerned with the specific resources and exploitative techniques employed by this group, the long-term cycle of repetitive choices in energy expenditure through a total subsistence round determines the adaptive pattern. The fact that the total subsistence round is the minimal unit of consideration is vital to the focal-diffuse concept" (Cleland 1976:60).

The second assumption,

> "is, under a specific set of environmental conditions and with the implementation of a particular technology, regular,

> consistent, and predictable patterns of resource exploitation will develop" (Cleland 1976:60).

The last assumption is that economic or adaptive systems are evolutionary. According to Cleland (1976), these systems must not be viewed as static entities, but it must be realized that the search for "economic security" ultimately leads to changes in the adaptive system.

The focal adaptation, according to Cleland (1976), is centered economically on the intensive exploitation of one or two species of plants or animals. By exploiting a limited number of resources, a degree of economic security in a particular resource is essential. This system is characterized by static, traditional labor groups utilizing a limited number of tool forms (Cleland 1976:62). Residency of a group in a particular area is dependent upon resource availability. Examples of this type of adaptation include exclusive hunting societies and groups cultivating domestic plants such as maize (Cleland 1976).

Although focal economics are centered on particular plant and animal species, secondary resources are utilized to various degrees. Citing examples from Cahokia, Aztalan, Carcajou Point, Lasley's Point and Bell sites, Cleland (1966:83) argues that horticultural groups exploited large cervids such as white-tailed deer (<u>Odocoileus</u> <u>virginianus</u>) to supplement their agricultural diet. Cleland (1966), hypothesizes that as more time was spent on horticultural pursuits, hunting became more selective and specialized. Because hunting would be limited, prehistoric hunters would be attracted to large packages such as the cervids. Cleland (1966) argues that a large preponderance of deer bone found at archaeological sites indicates that agriculture is important in the subsistence system. Mississippian research confirms that hunting is more selective (see Smith 1975), but whether or not this is the case in Oneota must be examined.

Diametrically opposed to a focal adaptation is the diffuse adaptation (Cleland 1966). As the term diffuse implies, this adaptation centers on the exploitation of a variety of resources, during various times in the annual cycle. This expolitive pattern, according to Cleland (1976), demands that tool assemblage and variety be expanded to extract a broader variety of resources. Whereas the focal adaptation is rather inflexible in its scheduling round because of its emphasis on one particular resource, the diffuse adaptation allows a greater number of choices to be made. This is not to say that a diffuse economy may not be very rigidly scheduled. The focal adaptation usually leads to sites that show indications of a particular resource being intensively utilized, while the diffuse adaptation is characterized by evidence of extensive utilization of resources (Cleland 1976:64). It must also be stressed that storage ability is difficult for a diffuse economy. A major disadvantage of the diffuse adaptation, according to Cleland, is that "since peoples with diffuse economies for the most part are bounded by the natural availability of food of low quality, they cannot profit for any length of time by windfall surplus. The system requires that normal scheduling is maintained" (Cleland 1976:65).

As mentioned previously, the focal-diffuse adaptive continuum can be viewed as evolutionary. Cleland (1976) describes diffuse economies as being "pre-adapted" to focal pursuits since peoples extracting a broad resource spectrum can experiment with a variety of plant and animal resources. However, the evolution of the focal economy to a diffuse adaptation causes a major change in the socio-technological structure. Expanding the economic base, according to Cleland (1976), calls for "new techniques of exploitation, adjusted social and political patterns, and new ideology" (Cleland 1976:66). The current of economic transformation and change from a focal to diffuse adaptation is central to the analysis of Oneota subsistence and settlement practices.

Based on his reconstruction of the biotic provinces and more specifically the microenvironments found within these provinces, as well as the Focal-Diffuse concept, Cleland (1966) summarizes the subsistence and settlement practices of the five Oneota phases. "The Lake Winnebago focus (phase) is restricted to an area of ecological transition between the grasslands of the Central Plains province and the woodlands of the Eastern Ridge and Lowland province" (Cleland 1966:87). Citing the faunal analysis of Lasley's Point, it is argued that people largely exploited plants and animals from aquatic habitats, and that the Lake Winnebago phase may be characterized as an economy utilizing maise agriculture with a secondary emphasis on deer and aquatic plants and animals.

Using Carcajou Point (Hall 1962), of the Koshkonong phase, Cleland argues that the microenvironments and climate of this more southerly phase would provide a more viable context for utilization of maize than a northern phase. A large amount of deer bone was identified from Carcajou Point, potentially indicating an adaptation based primarily on maize horticulture supplemented by cervids (Cleland 1966). As in the case of Lasley's Point, aquatic resources were also important.

The Grand River focus, according to Cleland, "is confined to the rolling hills of the eastern part of the central Plains province. This area was one of ecological transition between grasslands and woodlands and could perhaps be characterized as open woodlands" (Cleland 1966:87). At the time Cleland (1966) described this phase, no faunal assemblage had been analyzed for a Grand River phase site. However, Cleland hypothesizes that large cervids such as bison and elk may have been exploited, as well as maize horticulture.

In 1966, little was also known about the Green Bay phase, which was restricted to the wooded regions of the Door Peninsula of Wisconsin. Based on its location in relation to Lake Michigan, Cleland (1966) maintains that microenvironments different from those in the other phases would be found. The adaptation of these people would be restricted to these zones and would be particular to this cultural phase.

The last phase Cleland describes is the Orr phase, first described by McKern (1945). The location of this phase is far removed locationally from the four more eastern phases, and is found on the "terraces and floodplains of the lower stream valleys of the Western Upland province" (Cleland 1966:87). According to Cleland (1966), the faunal remains from the Midway site, indicate that the "Orr focus (phase) has an economic pattern based upon hunting large and small woodland mammals, and catching some of the larger fish typical of the Mississippi River Drainage (Cleland 1966:88).

Although all five Oneota phases may be considered primarily focal (dependent upon maize horticulture) in their economic orientation, Cleland (1966, 1976) stresses that the focal-diffuse concept must be considered as an evolutionary continuum. Based on his analysis of the potential for growing maize, Cleland (1976) describes the position relationship along this continuum for Middle Mississippian and Upper Mississippian subsistence systems.

Cleland (1976) argues that Middle Mississippian represents a focal adaptation, because of the ability of these populations to stagger two maize crops in their 190 plus day growing season. He maintains that at Middle Mississippian sites, two crops of maize would hedge against failure of their food resource. Next in position to these Middle Mississippian sites, the Oneota culture(s) would be also primarily agricultural, but having a broader economic base than their Middle Mississippian counterparts. Cleland (1966, 1976) stresses that because the Oneota phases are found much further north in both the transitional zone of the Canadian/Carolinian biotic provinces and the Illinoian biotic province, two crops of maize would not be possible. The response of these groups would be to develop a broader economic base, based upon maize and secondary resources available locally. Stated succinctly, the broader based economies represented by various Oneota phases are differing adaptations to micro-environments having differing limitations to maize horticulture. Although these phases are culturally somewhat similar, Cleland (1966) maintains that ecological and economic differences based on site location have allowed for different cultural manifestations apparent in the archaeological record.

Whereas Cleland (1966, 1976) illustrated ecological, subsistence and cultural dissimilarity among the five Oneota phases, Overstreet's model (1976, 1978, 1981) described uniformity of subsistence and cultural practices through the Oneota cultural continuum. Working from a larger, more diverse data base, Overstreet (1976, 1978, 1981) cites evidence from his 1970's excavations at the Pipe site, as well as the Lasley's Point (Peske 1966, Cleland 1966), Walker-Hooper (Gibbon 1969, 1973) and Carcajou Point (Hall 1962) sites. Importantly, the data from the Walker-Hooper and Pipe sites were not available to Cleland (1966) when his model was proposed.

Overstreet's (1981) uniformity model is based largely on the writings of Peske (1966, 1971) and the exploitive model of Middle Mississippian described by Smith (1974). According to Overstreet,

> "The results of this approach lend strong support to the primary hypothesis of this research, that is, Eastern Wisconsin Oneota culture is characterized by a high degree of homegeneity and integrity of adaptive pattern in spite of posited differences in ceramics and environmental settings between components" (Overstreet 1981:463).

Importantly, it must be stressed here than Overstreet's model is based solely upon the four eastern most Oneota phases (Koshkonong, Grand River, Green Bay and Lake Winnebago) and excludes the western Orr phase. According to Overstreet (1978) the Orr phase represents an aberrant cultural manifestation, not directly associated with the eastern four phases.

Beginning with his doctoral dissertation (1976) and continuing with two subsequent articles (1978, 1981), Overstreet maintains that the Eastern Ridge and Lowland province represents a rather unique environmental situation. He argues that unlike Cleland's (1966) and Gibbon's (1969, 1973) interpretations of this environmental area, the diverse microenvironments or environs found within the location of these phases are equally represented throughout the entire eastern half of Wisconsin. That is to say, although there is a diversity of environments found surrounding a particular site and between sites, for example eight vegetation zones in association with the Pipe site (Overstreet 1981:372), the four eastern Oneota phases exploited similar microenvironments. Utilizing historical vegetative records, faunal and floral analyses, Overstreet (1981) reconstructs the environments of the Lasley's Point, Carcajou Point, Walker-Hooper sites, and more specifically the Pipe site. Patterns of exploitation, according to Overstreet (1981), begin to emerge. Generally speaking, these environmental zones are as follows: "1) forest zone, 2) prairie zone, 3) oak openings or savanna zone, 4) riverine-lacustrine zone, 5) marsh and/or swamp zone, and 6) horticultural zone" (Overstreet 1981:494). These zones, he maintains, were exploited to different degrees by the different Oneota populations. The exploitation of these resources followed a general "broad spectrum" economy.

Overstreet's model (1981) argues against two important considerations of Cleland's model. Overstreet (1981) maintains that based upon his analysis of the flora and fauna represented in the four eastern phases, the adaptation was one of a diffuse orientation, rather than focal, as described by Cleland. While recognizing the basic problems of faunal analysis, for example calculation of pounds of usable meat, minimum number of individuals, Overstreet (1981) maintains that this data lends itself more to general interpretation (Smith 1974), than the more specific (Cleland 1966). Arguing against Cleland's (1966, 1976) discussion of the selectivity of cervids by agriculturally-oriented populations, Overstreet (1981) stresses that based on minimum number of individuals and pounds of usable meat, a preponderance of white-tailed deer is not recognized. According to Overstreet (1981), at Walker-Hooper and Pipe, based on MNI and pounds of usable meat, deciduous forest and forest edge species were just as important as aquatic species. Because of this, Overstreet (1981) argues that peoples of the Grand River and Koshkonong phases were not primarily agricultural (focal) as Cleland (1966) describes. A similar comparison is made with Carcajou Point and Lasley's Point. This overall, diffuse orientation through the entire Oneota continuum (800 years, according to Overstreet, 1981) is characteristic of the adaptive pattern. Although maize horticulture is apparent, it remained only one of many resources exploited in the diffuse economy. He does however, argue that an intensification of maize horticulture occurred in the Lake Winnebago phase, but the economic focalization Cleland (1966) suggests did not occur (Overstreet 1981:494).

As a further consideration of his analysis, Overstreet (1981:479) maintains that the intensive utilization of these diffuse resources, as well as viable storage techniques, allowed these Oneota sites to be inhabited throughout the entire year. He claims that these environs produced foods throughout the entire year, allowing Oneota peoples to utilize a full range of resources without dispersing to other areas. Although Overstreet (1981) maintains that Cleland's description of a "diffuse" economy fits closely with his model for Eastern Oneota adaptation, it does differ slightly. As stated previously in the description of diffuse economies (page 5) these economies follow an extensive, rather than intensive use of environments and resources. According to Cleland (1966), diffuse economies can not readily utilize an abundance of any one resource in any particular season.

The economic and cultural differences noted between the four eastern Oneota phases represent temporal and cultural changes, according to Overstreet (1981). Citing Hall (1962) and the radiocarbon chronology of Eastern Wisconsin, he described four stages of Oneota development (Overstreet 1978, 1981). Although difficult to define archaeologically the Emergent Horizon, A.D., 800-1000, is described by various authors (Griffin 1960, Gibbon 1969, Hurley 1975) as the incipient development of the Oneota lifeway. The Developmental Horizon, A.D. 1000-1300, includes the early Koshkonong phase, the Grand River phase, and perhaps elements of the Green Bay phase. The Classic Horizon, A.D. 1300-1650, is defined by the Lake Winnebago phase. Overstreet (1981) argues that the late Koshkonong phase may be transitional between the Development and Classic Horizons. Based upon the cited evidence (Overstreet 1981) this is difficult to state unequivocally. The Historic Horizon, Post A.D. 1650, reflects the possibility that the Classic Oneota are represented by the Historic Winnebago. This however, must only be considered tentative (Overstreet 1981:511). A complete description of these cultural stages may be found in Overstreet (1978, 1981) and Hall (1962).

These stages, according to Overstreet (1981) suggest that cultural and economic assemblages vary because these phases were not temporally coeval. He concludes that cultural and economic changes occurred which influenced the artifact assemblages represented at the various Oneota sites. From an economic standpoint, therefore, a diffuse economic orientation prevades the entire Oneota continuum with intensification of maize horticulture in the Classic Horizon.

The models proposed by Cleland (1966) and Overstreet (1978, 1981) provide important questions for further research in eastern Wisconsin. The research described in this thesis directly addresses the dichotomy between these models. Although not addressed specifically, the settlement and subsistence practices described by Gibbon (1969, 1972, 1973) also have bearing upon this research.

The question of ecological and environmental exploitation and economic orientation is paramount to the interpretations described in these models and the research of this thesis is directed toward how these factore relate to Oneota subsistence practices. Initially (Chapter II), this research begins with an in depth paleoenvironmental reconstruction of the area surrounding the Sauer Resort site. This reconstruction, based upon detailed geomorphological and historical data, describes the vegetation and faunal communities possibly exploited by peoples inhabiting the Sauer Resort site. Thus, comparisons can be made between the environments surrounding the Pipe (Overstreet 1976, 1978, 1981), Walker-Hooper (Gibbon 1969, 1973), Lasley's Point (Peske 1966, Cleland 1966), and Carcajou Point (Hall 1962) sites. Although this reconstruction and analysis differs in degree, it follows a similar research trajectory as Cleland's (1966) and Overstreet's (1976, 1978, 1981) research designs. This ultimately allows comparisons to be made between the environments exploited at the Sauer Resort site and other Oneota sites.

In Chapter III, the faunal analysis of the materials excavated during the 1978 season at the Sauer Resort site presents a significant body of new subsistence data. One of the problems Overstreet (1978) cites with Cleland's (1966) analysis is that he bases his conclusions on what Overstreet considers "incomplete and varied samples of faunal remains" (Overstreet 1978:28). Because of the extensive nature and excellent preservation of the excavated materials, the faunal analysis of the Sauer Resort site will present a "complete" sample. Importantly, the analysis of the species and environs exploited, scheduling and site seasonality will provide valuable data commensurate with the data described by Cleland (1966) and Overstreet (1978, 1981).

In the concluding chapter (IV), the significance of the Sauer Resort site data (Chapters I-IV) will be compared to the models proposed by Cleland (1966) and Overstreet (1981). Also, in keeping with a regional perspective as described by these models, the information gained by the historical and environmental reconstruction and faunal analyses is compared with the data from other Oneota sites. These comparisons may ultimately lead to the refinement and elaboration of these models.

CHAPTER II

RECONSTRUCTION OF THE PREHISTORIC ENVIRONMENT

Ecological Models

In the past 10 to 20 years, archaeologists have written a plethora of articles emphasizing the interrelationship of prehistoric human populations and their natural environment (see King and Graham 1981). In attempting to place human populations in their natural environment, archaeologists employing ecological or environmental approaches have taken on an interdisciplinary orientation. Combining fields such as ecology, geology, geomorphology, botany and palynology, authors have added much to the understanding of human interaction with the environment. However, this new orientation is not without its inherent difficulties and limitations. The difficulties and limitations as well as the usefulness of the ecological approach have been reviewed by Butzer (1976), Rhoades (1978) and King and Graham (1981).

The primary criticism directed towards archaeologists using ecological models is that oftentimes simplistic models have been employed which may or may not actually exist in the real world. Because of this criticism, archaeologists have been forced to be more introspective of their approach to ecological models. In discussing the ecological and environmental orientation of this thesis, it is valuable to briefly describe the status of ecological theory and how it relates to archaeological analysis. Acknowledging the fact that limitations as well as precautions must be taken in an ecological analysis, this discussion is directed towards many of the problems encountered by past analyses.

Many ecological models and concepts (such as ecotones) employed by archaeologists are based upon the notion of the ecological community. Communities are characterized by a group of plant species occupying a particular unit of space. Definition of such communities presents a problem to ecologists and archaeologists alike. Originally, communities were described as plant communities alone, with animals being incorporated in the definition much later (King and Graham 1981:129). Since plant and animal communities do not always coincide and the interaction of the various species are difficult to ascertain, two schools of thought concerning these phenomena have developed. Ecologists concerned with "biomes", or the group of related biotic communities, have attempted to understand how these communities are organized and how they operate (King and Graham 1981:129). The earliest explanation for this phenomena (late 1940's), known as the "organismic" school contends that communities, like organisms; have function and structure (definable boundries) (Odum 1953). The opposing school, or "individualistic" viewpoint emphasizes that species form communities, and that since "ecological requirements of the individual species differ, sharp boundaries between 'communities' do not exist" (King and Graham 1981:129). These concepts are particularly valuable to archaeologists in chosing an ecological model. If communities do not have definable boundaries it is impossible to infer relationships between them. Therefore, as in the case of the ecotone, discussion of the environment in this manner becomes meaningless. Inferring function of a site based upon its location to plant and animal communities also becomes difficult.

Although many archaeologists have been criticized by their peers (Butzer 1975, Rhoades 1978, King and Graham 1981) and ecologists for following the "organismic" school, calling it self-serving and overly simplistic, it remains the most widely held view. A variety of factors are responsible for this viewpoint. Primarily, archaeologists are not empirically oriented field ecologists. Because of the orientation of their research design and their limited background in allied disciplines, archaeologists do not concentrate their efforts in this direction. Secondly, ecologists working with modern data find it difficult to quantify and describe the interrelationships of plants and animals communities; therefore, this problem is further amplified when attempts are made to reconstruct past ecological situations. Thirdly, modern environmental conditions do not always reflect the prehistoric condition and archaeologists must rely upon historic documentation to reconstruct the prehistoric environment. This historic documentation was often compiled by naturalists using an "organismic" approach. Finally, archaeologists studying patterns of human behavior often assume that the environment in which humans live is patterned as well. In the construction of models, archaeologists are forced to make concessions. Every model, no matter how detailed, has its limitations. Realizing these limitations is most important.

Appreciating the problems inherent in the "organismic" approach, this orientation remains the most plausible for this description. Because Cleland (1966) and Overstreet (1976, 1981) describe environmental communities in this manner and because of the problem orientation of this research, the palaeoenvironmental reconstruction of the area surrounding the Sauer Resort Site is directed in this manner, although particular attention has been paid to problems encountered by other archaeologists utilizing this approach (Rhoades 1978, King and Graham 1981). It is valuable here to briefly describe these problems and their possible solutions.

One common approach to paleoenvironmental reconstruction is the use of faunal analysis based upon archaeological materials to infer past environmental conditions. Archaeologists, such as Michlovic (1980) have attempted to correlate known species of animals with the environments in which they live. Reconstructing environments based upon known fauna often cause these analyses to be considered tenuous (Grayson 1981). Faunal analysts have long appreciated that archaeological assemblages are not representative of the total number of species found within a particular region (Cleland 1966) and have argued that environmental reconstruction based on recovered fauna presents a biased perspective (Grayson 1981). In order to hedge against this apparent bias, this analysis incorporates not only a complete faunal analysis, but data on modern geological, geomorphological and botanical evidence, as well as historical documentation.

Historical documentation, invaluable in paleo-environmental reconstruction does have its limitations. The historical material compiled for the area surrounding the Sauer Resort site was collected from an organismic perspective. In using these materials, it becomes apparent that a bias has occurred. Naturalists often interested in the economic productivity of a particular region described dominant plant species which were economically profitable. Hence, dominant canopy species are often described, while understory species are ignored. Understory species, however, must be considered an integral part of the communities described. Information not apparent in the historic record must be derived from modern sources. Throughout this discussion an attempt has been made to integrate historical and modern data in order to present a more holistic perspective.

Critics of the "organismic" approach (Rhoades 1978) have argued phenomena such as "ecotones" and "edge effect" have been treated as ecological givens. These phenomena, not always apparent must be described and evaluated. Testing the model of edge-effect, modern wildlife management experts have created an edge-effect by cutting and slashing in climax forests. Because examples of this phenomena have been created synthetically, it becomes essential to evaluate where and when they occur in a natural situation (Rhoades 1978:611).

A consideration often ignored by archaeologists is the fact that human intervention occurred during habitation of a site which altered the vegetation and animal communities surrounding the site. Intentional burning, gardening activities and human habitation of a particular area impact and alter these communities. These activities produce an ever changing environmental situation. These changes make it important to perceive these communities as dynamic, rather than static entities.

Glacial Geomorphology

Determining and understanding the impact of glacial processes upon the land surfaces surrounding an archaeological site provides valuable information for the reconstruction of the past environment. Since slope, drainage, water availability, soil type, as well as overall topography at the Sauer Resort site directly result from glacial activity, the description of these factors and their relationship to human habitation must be considered. Appreciating the relationship between geologic and geomorphic features and human utilization of these resources, early geologists such as Chamberlin (1873-1877) published a four volume, comprehensive description entitled The Geology of Wisconsin. Although archaic in terminology, many of the processes described by Chamberlin (1877) for the eastern half of Wisconsin are still accepted as accurate. Modern researchers such as McKee (1971) and McKee and Laudon (1972) have further described the glacial processes first illustrated by Chanberlin

(1877). In particular, the research of McKee and Laudon (1972) centers on the glacial processes that produced the Fox-Wolf drainage. Combining these data provides a diachronic perspective on the geological research of this area.

Although affected by previous glacial episodes, the eastern half of Wisconsin has been most recently altered by the Valders Advance, dated to approximately 15,000 B.P. This large ice mass was derived from the northeast, and spread to the southwest across what is currently the State of Wisconsin. Using the remnants of glacial striations on bedrock and evidence of terminal morraines, Chamberlin (1877) illustrates the extent of this glacial episode (Figure 2). As Figure 2 shows, the retreating ice mass produced a variety of topographic features and drainage patterns. Most importantly, the results of this glaciation produced the Fox-Wolf drainage.

In attempting to reconstruct the glacial action that produced the Fox-Wolf drainage, McKee (1971) and McKee and Laudon (1972) used a variety of methods. By inspecting glacial remnants (i.e. beach formations, flood plains, till banks) and cores from the bottom of the drainage itself, two formative episodes have been documented. Initially, a large glacial lake, known as Glacial Lake Oshkosh, was formed by the retreating of the Valders ice sheet (McKee 1971). This broad, shallow lake occupied a basin produced by down cutting of the bedrock formation known as the Potsdam Sandstone (Chamberlin 1877). This lake drained into the Mississippi River to the southwest while drainage was restricted to the northeast by the retreating ice sheet. McKee and Laudon (1972) maintain that the exact size of this lake is not known because later drainage processes obliterated the evidence, but a conservative estimate would be at least 416 square kilometers. Core samples taken down river from Lake

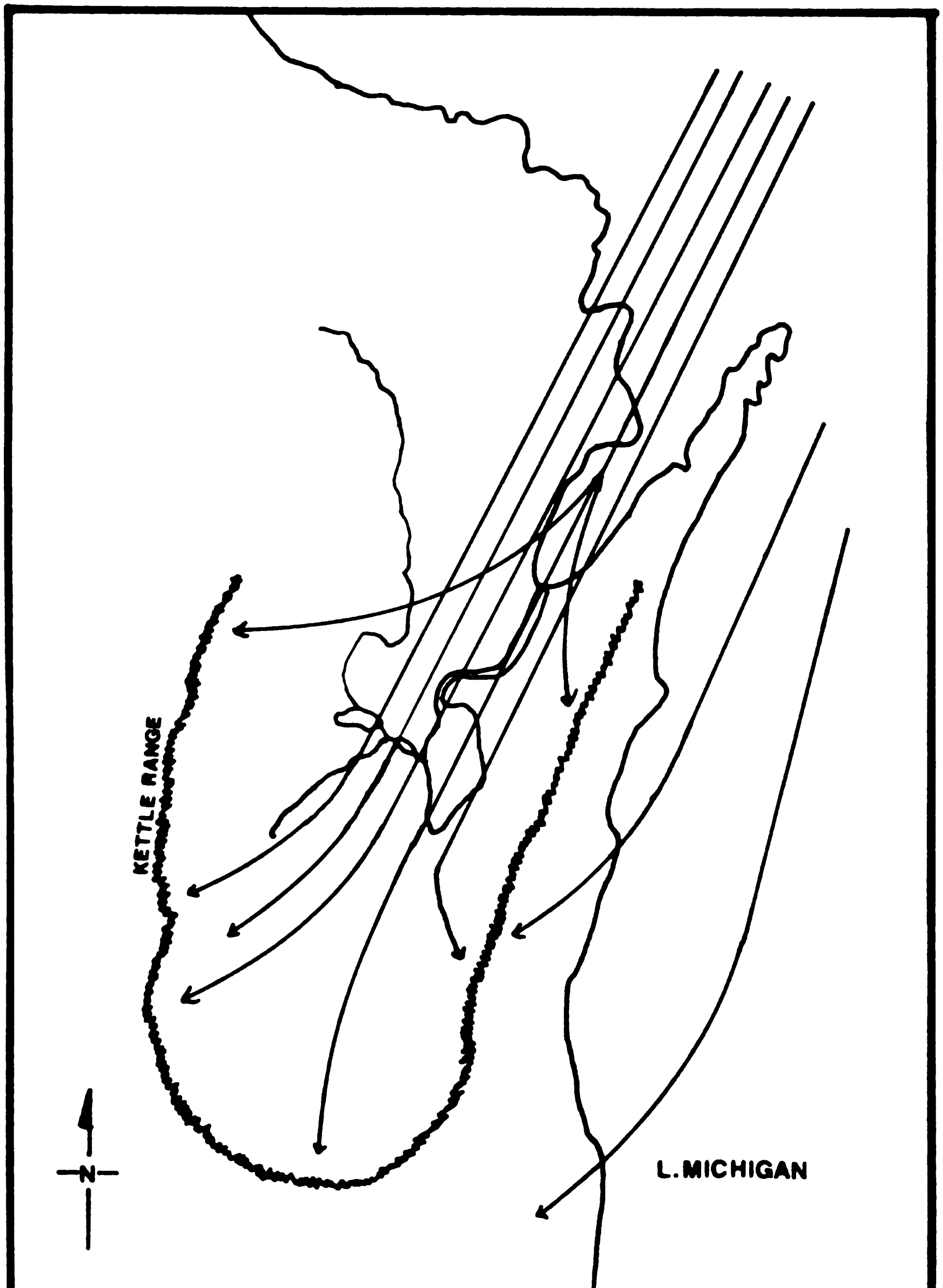

Figure 2 Glacial Movements in Eastern Wisconsin

Poygan indicate that this first Glacial Lake Oshkosh was a shallow, oligotrophic lake. As is characteristic of an oligotrophic stage, the lake supported a fine, sandy bottom with a well-developed, rooted plant community.

For unknown reasons, this lake suddenly deepened. McKee (1971) speculates that a drainage obstruction or an increase flow of water into the lake may have been responsible for the increased depth. Since this lake was large, deep, clear and cold it has been named Later Glacial Lake Oshkosh. Fine, seasonally banded red clays accumulated in the deeper sections of the Later Glacial Lake Oshkosh and are preserved beneath the floor of the present drainage system (McKee and Laudon 1972). According to McKee (1971), it is impossible to determine the total thickness of these clays because when the lake became shallow and drainage was restored to the northeast, much of these clays were washed downriver. It is apparent, however, that they were deposited in an oligotrophic stage because as overlying sediments are examined, recent organic sediments (evidence of eutrophication) are found (McKee 1971). Figure 3, adapted from a block profile drawn by Chamberlin (1877) illustrates the alternate banding of clays, sand and till. As is apparent from this figure, Lake Poygan rests upon the clay bottom sediments of the Later Glacial Lake Oshkosh. Because the bedrock formation of Potsdam sandstone represents an easily eroded basement, glacial lake stages have scopped or scoured out a relatively deep basin. Lake Poygan, Lake Winneconne, Lake Butte des Morts and Lake Winnebago are the remnant water bodies of this glacial lake stage and are found in the deepest sections of the basin inundated during and after the Valders advance. The alternating clay and sand strata correspond to the cultural strata described in Appendix A. The geological matrix found in the cultural stratigraphy of the Sauer Resort

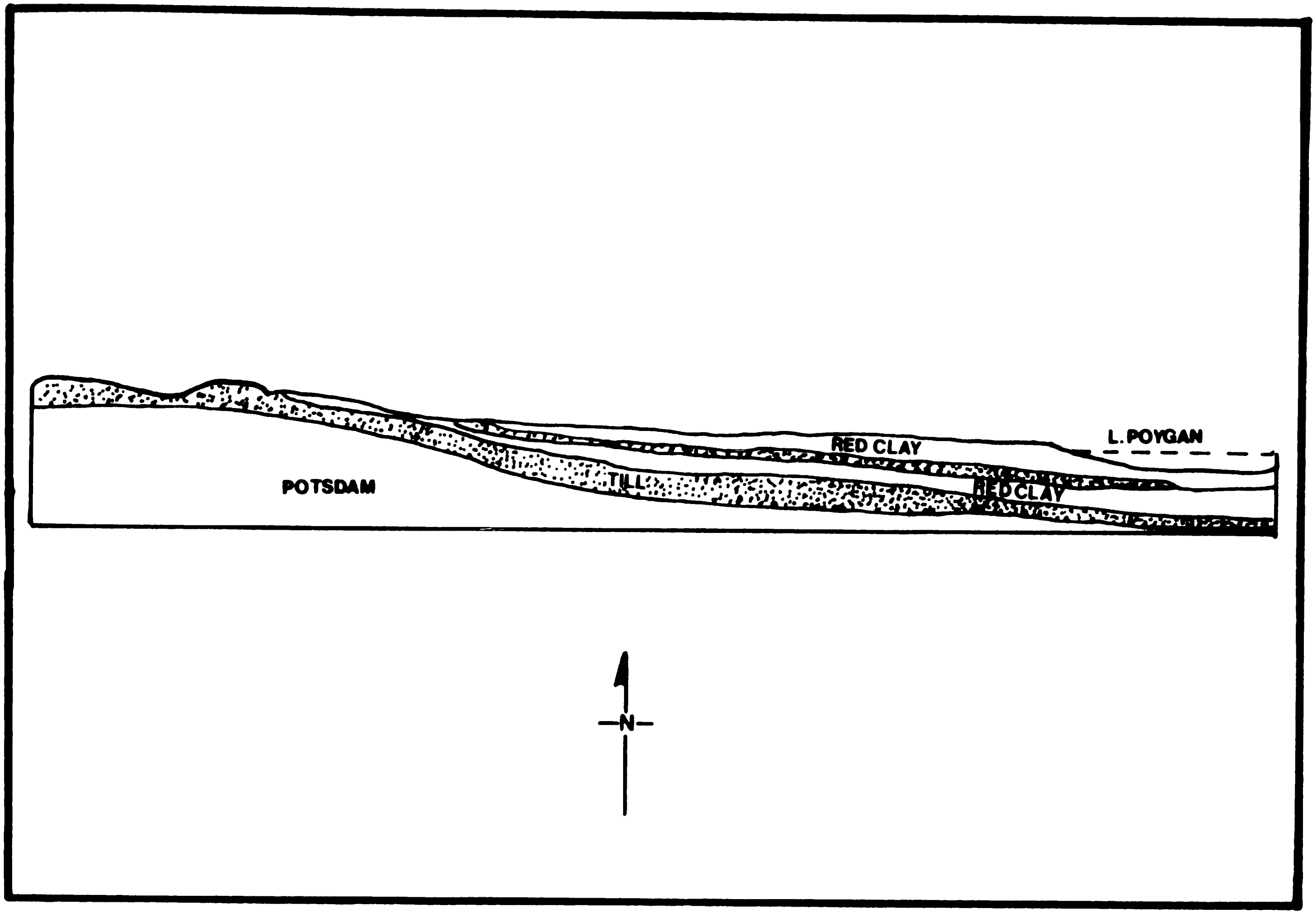

Figure 3 Profile of Glacial Stratigraphy West of Lake Poygan

site is largely derived from bottom (clay) and beach formations (sand) from the Later Glacial Lake Oshkosh.

These beach and lake bottom formations of the Later Glacial Lake Oshkosh provide interesting data for the archaeologist working within the Fox-Wolf watershed. The beach formations of the Later Glacial Lake Oshkosh provide excellent habitation sites for prehistoric populations. The permeability of these formations and the accessability to various resources, make these excellent sites. Faulkner (1972) surveyed the entire Middle Fox and Wolf drainages and documented that these beach formations were areas preferred by prehistoric populations. With later prehistoric populations, the availability of clay for ceramic production becomes important. The finely sorted, homogeneous clays found beneath these beach formations provide excellent ceramic clays. It is apparent that these clays were exploited by prehistoric potters (Seurer, personal communication).

As Lake Poygan, Lake Winneconne, Lake Butte des Morts and Lake Winnebago shallowed, the Fox and Wolf rivers added a large volume of sediment into them. McKee and Laudon (1972) maintain that the sediment load carried by these rivers was much greater during the immediate postglacial period than is carried presently. These fine, organic sediments, produced at the mouth of the Wolf and Fox rivers, formed a large underwater delta. In Figure 4, the extent of this delta is described for Lake Poygan. Although it is impossible to determine the extent of this deltaic buildup, it may have extended to the southern shore of Lake Poygan. The middle of the lake, where sediments would have been redeposited by current action, may well have been devoid of these sediments. Linde (1974) also argues that this delta was dynamic since it would be constantly reworked by both increases in sediment load and seasonal increases in water levels. On this sand, silt plain, emergent and submergent vegetation soon moved

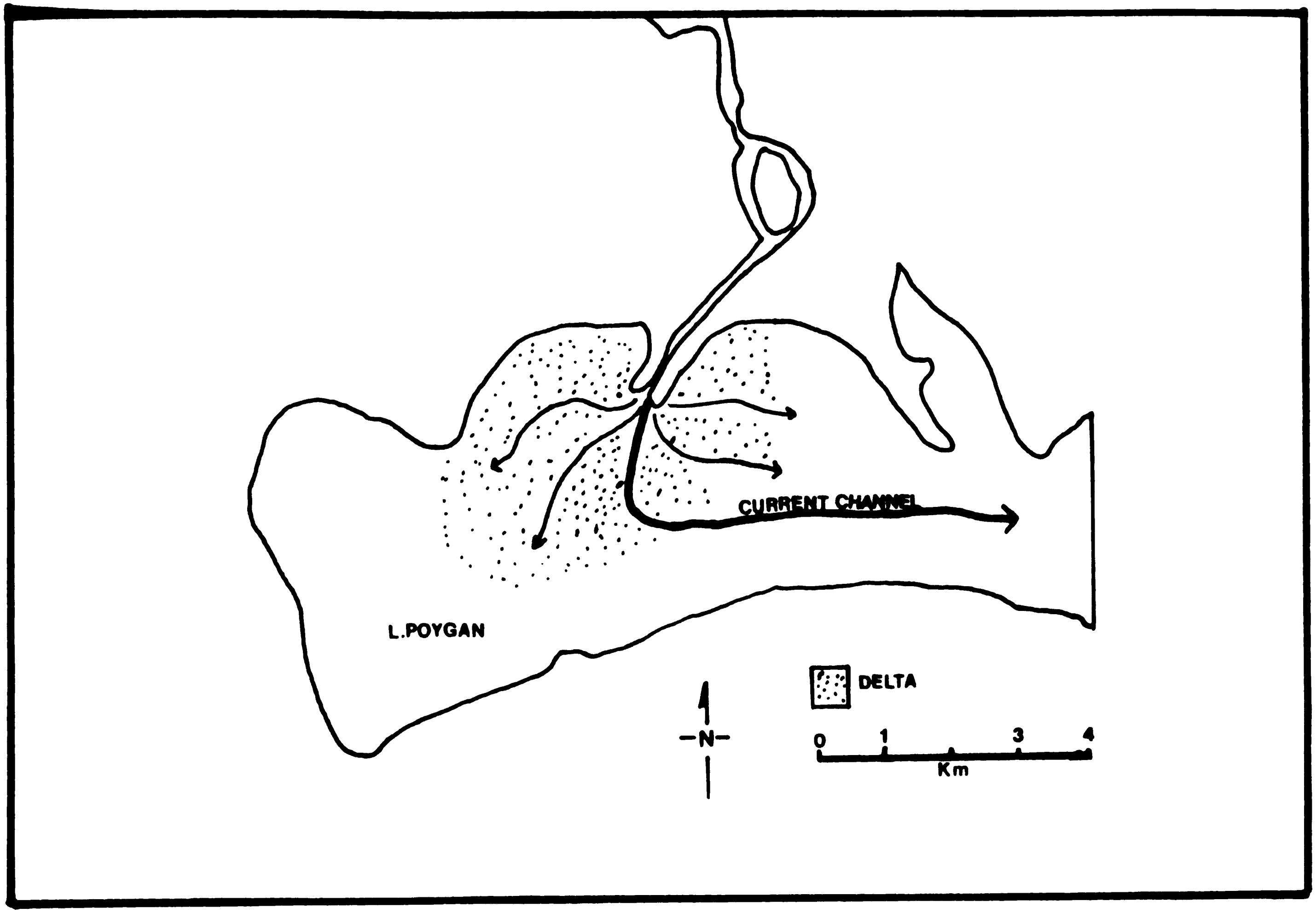

Figure 4 Formation of Submerged Delta at the Mouth of the Wolf River

out from the shoreline (McKee 1971) while concurrently a semi-fluid organic ooze was spread over the sterile sand. The extend of the vegetation was limited by the extent of the deltaic sediments. Therefore, at the height of the emergent-submergent proliferation only a channel in the middle of Lake Poygan was evident.

Presently the Fox and Wolf rivers drain approximately 15,678 km^2, referred to as the Winnebago Pool, and composed of four lakes (Poygan, Winneconne, Butte des Morts, Winnebago) with Lake Winnebago (759 km^2) being the largest. These lakes were formed by a till dam, which restricts the outflow of the Fox River at Neenah and Menash (Figure AI). According to Linde (1974) the maximum pool inflow at flood peak is 40,000 cfs, but the greatest outflow possible is only 15,000 cfs. It is obvious that the Winnebago Pool serves as a large reservoir.

Glacio-fluvial processes which produced the Fox-Wolf drainage are also responsible for soil types surrounding the perimeters of these lakes and rivers. Soil surveys, such as those conducted by the U. S. Department of Agriculture and the Wisconsin Geological and Natural History Survey (Anderson et al. 1927) describe the characteristics of these soil types. The important soil types surrounding the Sauer Resort site will be described in depth in the section of this chapter dealing with the various vegetation communities.

Physiographic Provinces

Based upon glacial features and underlying bedrock formations, physical geographers such as Martin (1965) have described various physiographic provinces. Archaeologists working within the State of Wisconsin have used these descriptions in order to locate various archaeological sites. Cleland (1966) and Overstreet (1976, 1978, 1981) have used these provinces to describe the location of the five Oneota phases (Chapter I).

Figure 5 illustrates the physiographic provinces of the Fox-Wolf drainage. As stated previously, the Lake Winnebago phase is confined to the border region of the Central Plains province and the Eastern Ridge and Lowlands. It must be stressed here than these provinces have been described based upon bedrock formations and glacial features and do not describe climate or vegetation conditions. The importance of these qualifications will be made clearer in succeeding chapters.

Historic Hydrological Changes in the Fox-Wolf Drainage

River systems, like other natural entities may be altered by human agencies. Changes in the Fox-Wolf drainage in the past 150 years have greatly affected the pristine, post-glacial environment described by McKee and Laudon (1972). As described in the initial section of this chapter, ecologists and archaeologists reconstructing past environmental conditions must assess changes based upon historical documentation and modern ecological impact studies. The historical documents pertaining to the Fox-Wolf drainage were written by officers from the Army Corps of Engineers who were affecting calculated changes on the river systems. These alterations, however, have disrupted the ecosystems of these two rivers. Modern ecologists, fresh water biologists and geologists, in an attempt to determine the impact of these changes and to make suggestions for the revitalization of the ecosystem, have described the conditions necessary to return these river drainages to their prehistoric condition. Using the historic record of changes as well as these modern scientific surveys, archaeologists working in this drainage can better reconstruct the prehistoric ecosystem. In order to appreciate the extent of these changes, the initial discussion, following a chronological orientation, outlines the impact of historical utilization of the Fox-Wolf drainage. The succeeding discussion describes the biological and geological processes

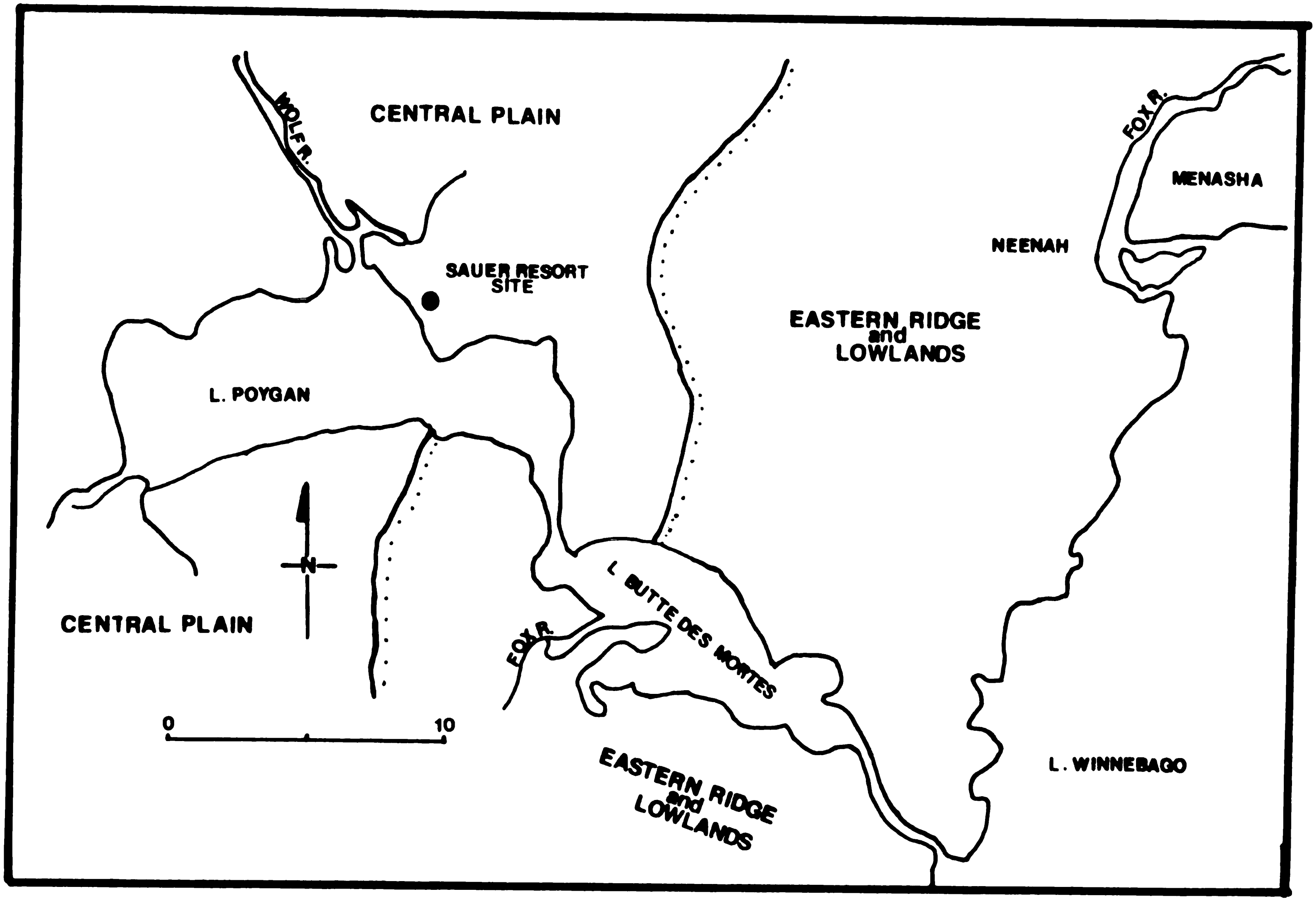

Figure 5 Major Physiographic Provinces of the Fox-Wolf Drainage

that caused these changes and illustrates the drainage reconstruction based upon historical and modern information.

Historic Utilization of the Fox-Wolf Drainage

Initial changes in the Fox-Wolf drainage began in the 1830's, when 43 temporary dams were constructed on the Upper Wolf River (Whitbeck 1915). These dams were privately owned and their effect on the vegetation and environment are difficult to ascertain. However, because of their size and construction, they probably had little effect on the drainage pattern. According to Pierpont (1878), the first large scale lumbering activities began in 1835 when rafts of logs were floated down river to a government mill in Neenah. This activity signaled the beginning of major alterations of the Fox-Wolf drainage system.

Early in the 1840's, the U. S. War Department, in the form of the Army Corps of Engineers, began a survey of the Fox-Wolf drainage. There were three motives for this survey. Initially, engineers were sent to determine if a canal could be built between the Wisconsin and Fox rivers, thus making it possible for steamboats from the Mississippi River to pass through the Fox River and ultimately to the Great Lakes. Since the Fox was a shallow river (approximately 3 ft. or .9 m), major dredging activities would also have to be instigated (Pierpont 1878). Secondly, more effective control of water levels would allow logs to be easily transported to mills downstream. Lastly, it was deemed imperative that water power would be needed to cut lumber downriver, and therefore this resource should be developed to its fullest capacity. However, because the Supreme Court had not decided who had control of the waterway, private companies such as the Green Bay and Mississippi Canal Company and the Wolf River Boom Company as well as the Army Corps of Engineers began improvements on the waterway (Thomas 1882). For 30 years, private and government groups affected changes on the Fox-Wolf drainage.

In 1846, in an attempt to improve steamboat navigation, a canal between the Wisconsin and Fox rivers was constructed (Hinaman 1879). According to Hinaman (1879), this canal allowed cheaper transportation of heavy, bulky products. Since a large influx of people were moving into the area to exploit the burgeoning lumber business, a large volume of goods would be necessary to supply towns downriver.

In 1847, a brush wing dam was constructed at Neenah by a private company. According to the charter for this dam, water levels up river were not to be effected. However, according to Overton (1931), this charter was often violated. In order to control and enforce the charter on the Neenah dam, the Army Corp of Engineers constructed a dam in Menasha in 1850 (Linde 1974). Together, these two dams controlled the water levels in the entire Winnebago Pool.

Between 1848 and 1862, the exact date unknown, the Wolf River Boom Company constructed a cut-off channel between the Wolf River and Boom Bay (Pierpont 1878). This cut-off allowed logs to be rafted in large quantities in the protection of Boom Bay. However, this cut-off had great impact on the Lower Wolf River. Large rafts of logs denuded areas of vegetation at the mouth of the river and in Boom Bay, causing the mouth to begin migrating to the east. This area is in very close proximity to the Sauer Resort site. Figure 6 illustrates the dams constructed in Neenah (1847) and Menasha (1850), as well as the boom cut-off at the mouth of the Wolf River. Assessing the vegetation changes up until 1862, Linde (1974) believes that only minor changes had occurred.

In the late 1860's and early 1870's, major steamboat shipping began on the Fox-Wolf waterway (Whitbeck 1915). At this time, the Army Corp of Engineers constructed a government shipping canal in Menasha.

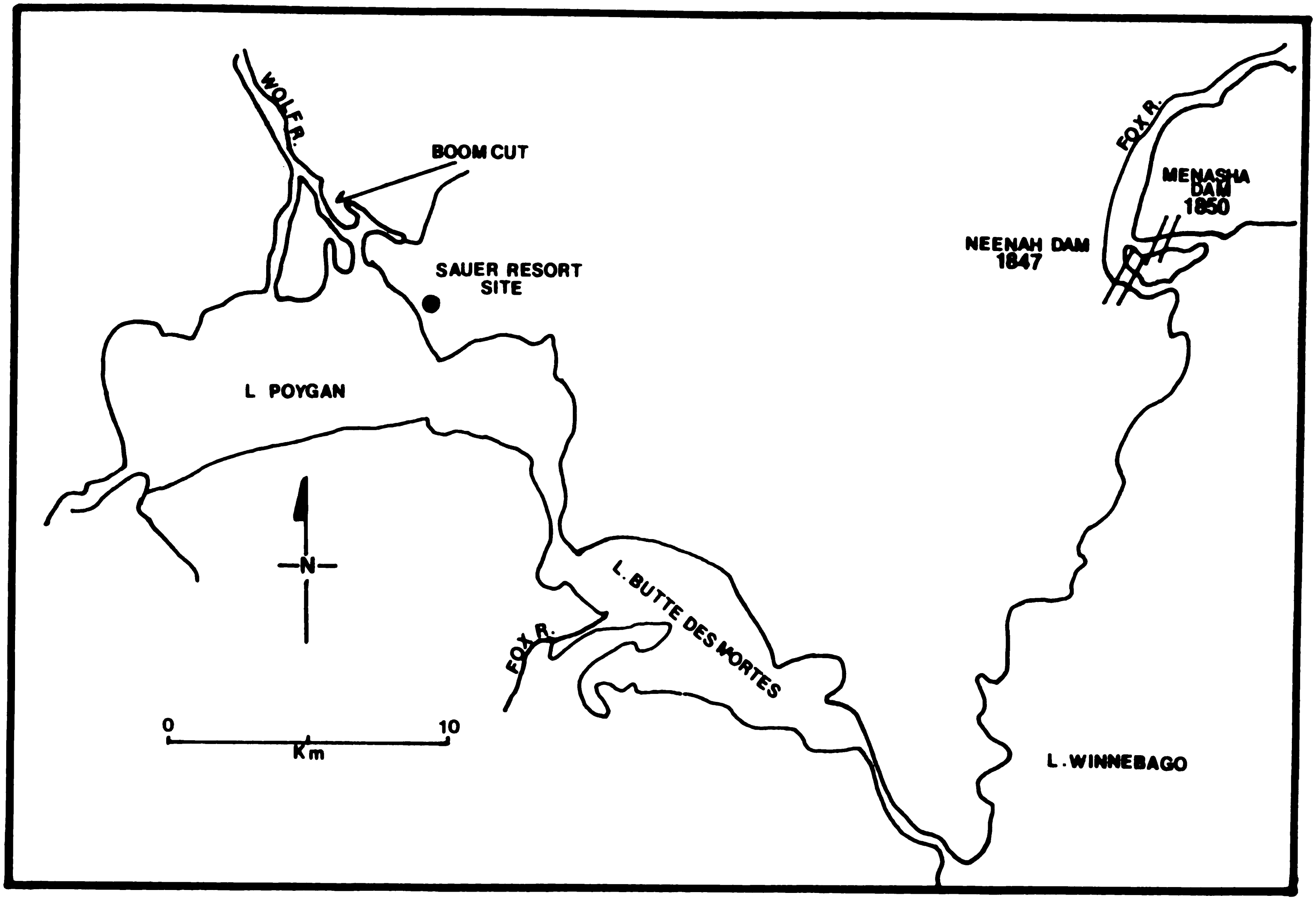

Figure 6 Wolf River Boom Cut and Downriver Damming

Beginning at this time, water levels in the Winnebago Pool greatly increased. For the purpose of navigation, the water was held high enough to increase the wetted perimeter of the pool by 5.5% over its original area (Juday 1914). In an attempt to further control the water levels in the Winnebago Pool, the Federal Government purchased all the dams and canals on the Fox River from the Green Bay and Mississippi Canal Company. This purchase included 22 locks, 11 dams and 7.5 miles (16.5 km) of canal (Houston 1880). After this purchase, only the dam at Neenah was held in private hands, but the Army Corp of Engineers began to monitor its operations more closely (Linde 1974). Additional dams were constructed on the Lower Fox River in succeeding years, with massive dredging efforts and cut-offs following (Houston 1880). These dredging efforts (776,687 cubic yards in two years), along with numerous cut-offs and damming activities, produced a mean depth of 6 feet (1.8 m) throughout the entire Fox River (Hinaman 1879, Houston 1880). By the late 1870's steamboat navigation along the Fox River was possible during the entire ice-free season (April-December). At this time, residents upriver began to complain to the U. S. Government that the increased water levels were damaging their land. Overton (1931) states that areas that were marshes were destroyed, while previously dry lands became marshes. In response to these allegations, the Army Corps of Engineers sent officers to investigate these claims (Thomas 1882).

Until the 1870's, little effort was made to alter the drainage pattern of the Wolf River. Besides the cut-off at Boom Bay, few or no changes had been enacted. Although water levels had been increased approximately 3 feet (1.9 m) in the Lower Fox River (due to dredging), the riverbed remained almost unaltered in the Wolf River drainage. In the late 1870's, John Pierpont conducted a 2 year hydrological survey of the

Wolf River. This survey was conducted to determine the cost of increasing the mean depth of the river to 3.5 feet (1.07 m) (Pierpont 1879). According to Pierpont (1879), before alteration the Wolf River drained approximately 11,180 km^2. Surveying the entire length of the river, Pierpont (1879) divided his soundings into 4 sections. The lower section had a mean depth of 3.03 feet (.92 m), the second section 3.06 feet (.93 m), the third section 2.44 feet (.74 m) and the upper section 2.74 feet (.84 m) (Pierpont 1879:13). This survey is particularly valuable because it was the only one conducted before alteration; thus allowing for a better appreciation of what prehistoric water depths may have been.

Documenting changes from 1883 to the present, Linde (1974) used Army Corp of Engineer records to determine average water levels in the Winnebago Pool. Linde's (1974) survey represent a synthetic discussion of water level changes and vegetation disruption during this time. According to Linde (1974), these records indicate that extreme water level fluctuations occurred from 1883 to 1895. For instance, on April 28, 1888 the water levels at Oshkosh were 5.84 feet (1.78 m) higher than on November 16, 1889. This high water level caused major destruction of the vegetation cover in the Winnebago Pool (Linde 1974). Based upon a map drawn in 1916, Linde argues that the vegetation of these lakes had begun to float. Whereas firmly rooted emergent vegetation had originally been present, a floating bog soon covered the lake. In 1922, for no apparent reason, the water level was held at 4.75 feet above the guage reading "0" at Oshkosh. During this year, heavy wave action and ice caused extensive vegetation loss.

In the following years, 1927-1960, major vegetation losses continued to occur. With these vegetation losses, major drainage alterations followed. Near the Boom Bay cutoff, a new mouth to the Wolf River was created, stranding the old channel. The old channel mouth had been located in sections 4 and 5 of the Town of Poygan, but now empties into Lake Poygan in section 27 of the Town of Wolf River. This migration of the river mouth places it 5 km closer to the Sauer Resort site. After the old channel was stranded and with increased water levels, the old channel bed became a large open slough (Page's Slough).

Drainage Reconstruction

In order to reconstruct the prehistoric Fox-Wolf drainage, the biological and geological processes which destroyed and altered the aquatic vegetation must be appreciated. Modern scientific surveys conducted by Olcott (1966), Harriamn (1970), Harrison (1970), Sloey (1970) and McKee and Laudon (1972) provide valuable information concerning these processes.

As water levels were increased in the Fox-Wolf drainage, a variety of factors influenced the destruction of vegetation and subsequent drainage alterations. As described in the opening section of this chapter, the aquatic vegetation of the Fox-Wolf drainage, for the most part, was a well-developed rooted plant community. When water levels, beginning in the 1870's, were raised many feet above their natural levels, many of the emergent plants could not tolerate this increase. The first vegetation losses occurred at this time, and the rise in water levels resulted in important seasonal changes. According to Harriamn (1970) and McKee and Laudon (1972), high water at the time of spring break-up (March-April) contributed to a further loss of vegetation. Ice frozen into the vegetation was lifted by the rising water levels tearing loose the roots of the emergent vegetation. producing a floating mat. This evolution from a rooted plant community to a floating mat is typical of this type of disruption (Linde 1974). With continuing high water and wave action, this bog mat gradually broke-up and floated downstream (Harrison 1970, McKee and Laudon 1972). Vegetation lost in this manner also affected the oxygen content of these lakes. When this vegetation sank to the bottom it decomposed, destroying the oxygen content and affecting plant and animal species. Because of vegetation loss, according to McKee and Laudon (1972), the sand and silt bottom of these lakes quickly eroded away due to wave action (see Figure 4), and as these sediments began to erode, a vast amount of these bottom sediments were moved downstream, causing the lakes to deepen. This further complicated the emergent plant tolerance problem. This deepening of the lakes and loss of organic bottom nutrients allowed for an even greater destruction of vegetation. Since these plants developed during a low water stage when mud flats were apparent, continued high water did not allow for the regeneration of the emergent and submergent plant community (Linde 1974). Since many of these degenerating processes are evident today, the continued loss of both submergent and emergent vegetation in the Fox-Wolf drainage is apparent. Based on these vegetation losses and the resulting deepening of the drainage, as well as the overall high water conditions. Linde (1974) calculates that the Fox-Wolf drainage is approximately 3 feet (.92 m) deeper than it was prehistorically.

Considering the geomorphological, geological, biological and historical information concerning the Fox-Wolf drainage, it is possible to illustrate the prehistoric drainage of these river systems. The documented evidence indicates that the water level increase of 3 feet (.92 m) changed the overall wetted perimeter of Lake Poygan (Linde 1974). Using a hydrographic map of Lake Poygan from 1916, a General Land Office survey map from 1840 (Seurer, personal communication), and reducing water levels based upon historic increases, it is possible to reconstruct the prehistoric boundary (prior to 1800 A.D.) of Lake Poygan and the Wolf River. Figure 7, illustrates these changes, as well as the historic migration of the mouth of the Wolf River and the creation of a large slough. As described in the following section, this drainage reconstruction aids in the reconstruction of prehistoric vegetation communities.

Reconstructing Prehistoric Vegetation Patterns

The reconstruction of prehistoric vegetation communities is contingent upon a variety of factors. Determinants such as slope, drainage, climate and soil conditions all combine to produce vegetation communities. The preceding sections of this chapter described the reconstruction of the slope and drainage of the Fox and Wolf rivers, and more specifically the area surrounding the Sauer Resort site. Because of the value of this data, it will be integrated in this section. As was the case in prior discussions, modern data will be used to evaluate the historic records of vegetation patterns surrounding the Sauer Resort site and to present a more inclusive data base. Due to this orientation, the following section proceeds from a general discussion based upon modern information, to a more specific modern/historical perspective.

One of the most often cited references in the archaeological literature concerning regional biotic differences is Dice's (1943) Biotic Provinces of North America (For example, see Cleland 1966). Dice, using peculiarities of vegetation type, ecological climax, flora, fauna, climate, physiography, and soil describes major "biotic provinces" of North America. According to Dice, "a biotic province may best be conceived of as a considerable geographical area over which the environmental complex produced by climate, topography, and soil is sufficiently uniform to permit the development of characteristic types of ecological association" (Dice 1943:5). Obviously, in these biotic provinces Dice was forced to

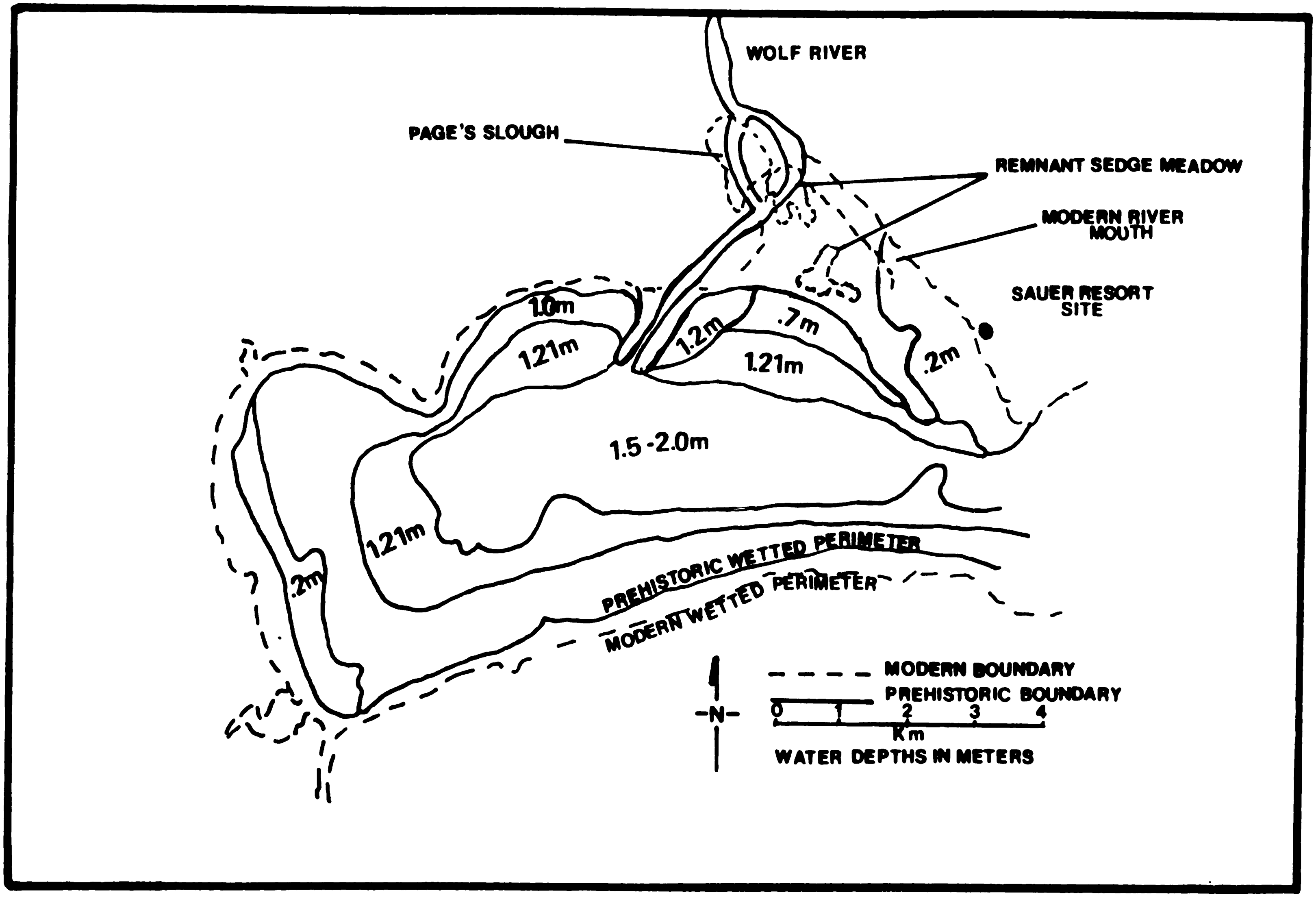

Figure 7 Historic Water Level Changes in the Wolf River and Lake Poygan

include a variety of vegetation communities under a single rubric. He acknowledges that, although these provinces are designed to include a multitude of determinants, they are often based upon floristic differences. Dice also readily admits that it is difficult to base biotic differences on known animal interaction. It is apparent from these groupings that Dice (1943) follows an "organismic" or community approach to ecological models. Because of this approach, these biotic provinces often fit well with the ecological models proposed by archaeologists.

For the State of Wisconsin, Dice (1943) delineates two biotic provinces, the northern Canadian and the more southern Illinoian. Figure 8 diagrams the demarcation of these provinces. The Canadian province is characterized by a hardwood forest climax, with several types of coniferous forests as important subclimax groups. This mixture of climax and subclimax forest types makes the Canadian province transitional in nature. The Carolinian province, which lies northeast of the Illinoian province, shares a vague border with the Canadian province. This undifferentiated border is apparent because both the Canadian and Carolinian provinces share a similar climax forest. According to Dice, these vegetation types are found in areas of low relief, although rolling hills are also defined. Glacial features such as morrainic hills, drumlins, eskers, and outwash plains are also characteristic of this province. Soils are largely derived from glacial parent material and consist of peat, muck, marl, clay, silt, sand, and gravel. Glacial erratics such as boulders are also found (Dice 1943:15).

The forest climax of the Canadian province consists of sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), yellow birch (*Betula lutea*), northern white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*) and basswood (*Tilia glabra*), with sugar maple being the most prevalent.

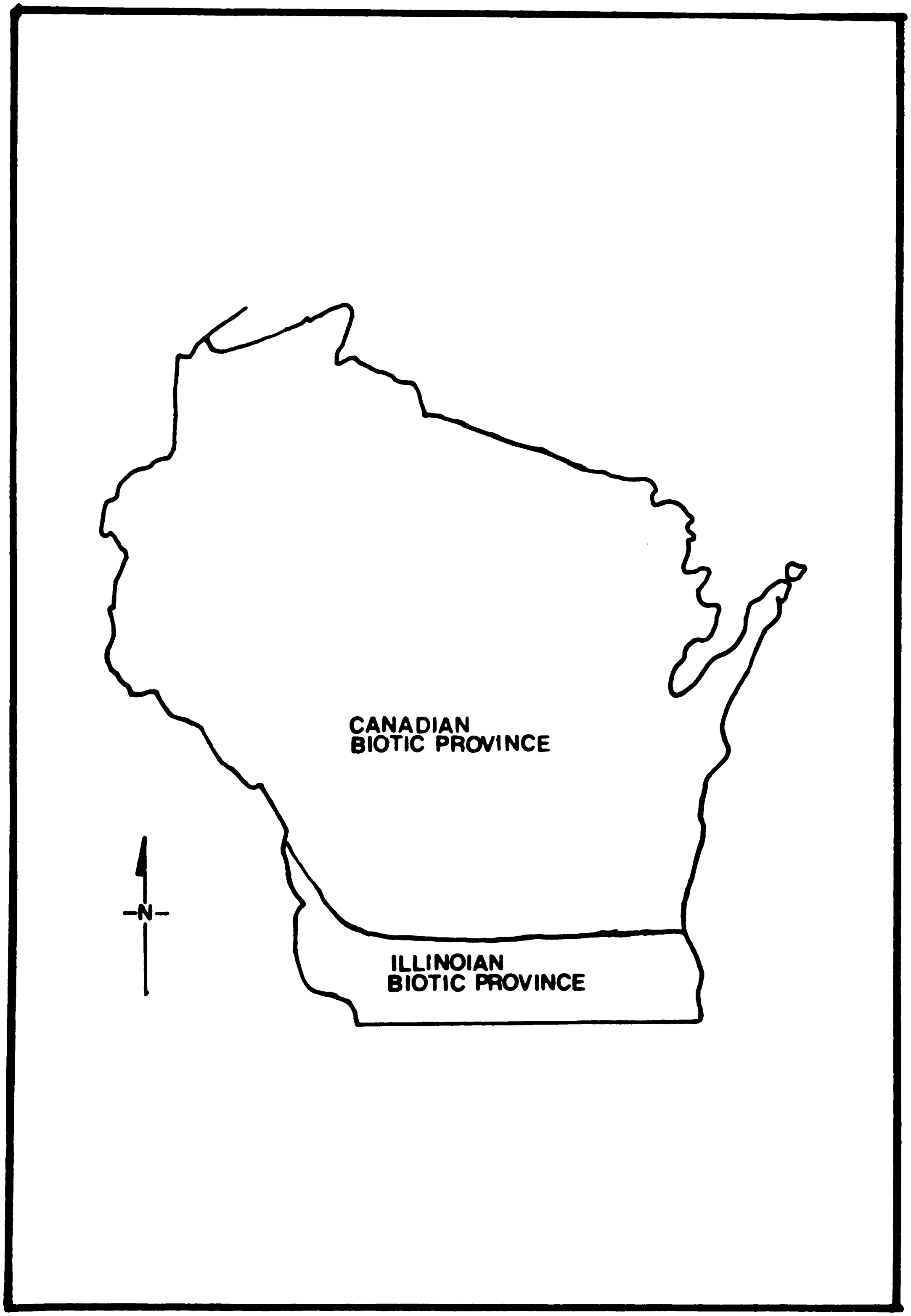

Figure 8 The Biotic Provinces of Wisconsin (Dice 1943)

Important subclimax bog species include black spruce, (*Picea mariana*), tamarack (*Lavix laricina*) and northern white cedar (*Thuja occidentalis*). In dry, sandy areas susceptible to burning, aspens such as *Populus tremuloides* or *P. grandidentata* may form a successional stage (Dice 1943: 15). The density and frequency of any of these species is contingent upon local conditions.

The Illinoian province, unlike the Canadian province, is defined by plant and animal species found outside of the Great Lakes watershed. The topography of this province is for the most part, gentle rolling to steep hills with numerous valleys. Based upon this topography and vegetation type, this province delineates the prehistoric expanse of "True Prairie" (Dice 1943:21). However, depending upon topography and the amount of available water, deciduous forests are also present. Whereas the tall grass praires are best represented in the western half of this province (Kansas, Nebraska), the mixture of this prairie with deciduous forests is more characteristic of the eastern section (i.e. Wisconsin). The upland forests are comprised of oaks and hickories and form what Dice (1943) refers to as the "Oak-Hickory Forest Association" (Dice 1943:22). On the flood plains and moist hillsides of this province, species such as elm (*Ulmus* sp.), sycamore (*Platanus occidentalis*), bur oak (*Quercus macrocarpa*), eastern cottonwood (*Populus deltoides*), hackberry (*Celtis occidentalis*), red bud (*Cereis canadensis*) and buckeye (*Aesculus* sp.) are found (Dice 1943:22). In the north eastern corner of the province (southern Wisconsin), soft maples, basswood and beech are also important.

Curtis (1959) citing his own data, and Cleland (1966) citing Dice's (1943) data further describe the biotic differences of Wisconsin. Using historical documentation and field data, Curtis (1959) illustrates two floristic provinces for the State of Wisconsin. Flora and floristic provinces, according to Curtis, are different than local plant communities in a quantitative sense. Stated succinctly, floristic descriptions are a total list of the plant species present with no emphasis placed upon the relative number of each species. That is to say, one thousand oak trees would be considered in the same manner as one oak seedling. Plant communities, however, describe a combination of plant species in a given area, with the relative frequency of each species noted. The plant communities within a single floristic province may vary in the kinds and the relative number of species represented (Curtis 1959:49). When all plant communities are considered for a particular area, it may be called the vegetation of a particular region. That is to say, vegetation of an area and the flora of an area may vary in that vegetation descriptions are quantitative and flora designations are qualitative. According to Curtis (1959), the combination of these data produce the most inclusive picture. From this data, regional vegetation patterns may be ascertained.

The floristic provinces of Wisconsin, according to Curtis (1959), may be divided into a southwestern province or prairie-forest, with the northeastern province designated the northern hardwoods. As is readily apparent Curtis' designations are very similar to Dice's (1943). However, as only alluded to by Dice (1943), Curtis (1959) illustrates a narrow band or zone which separates these provinces (Figure 9). This narrow band or tension zone contains plant species found in both floristic provinces. For many plant species this represents the furthest extension of their range. In the case of the southern or "Prairie element" and the northern or "Boreal element," these zones represent the most northern and southern occurences, respectively. Curtis (1959) argues that this tension zone has been apparent since postglacial times. He states,

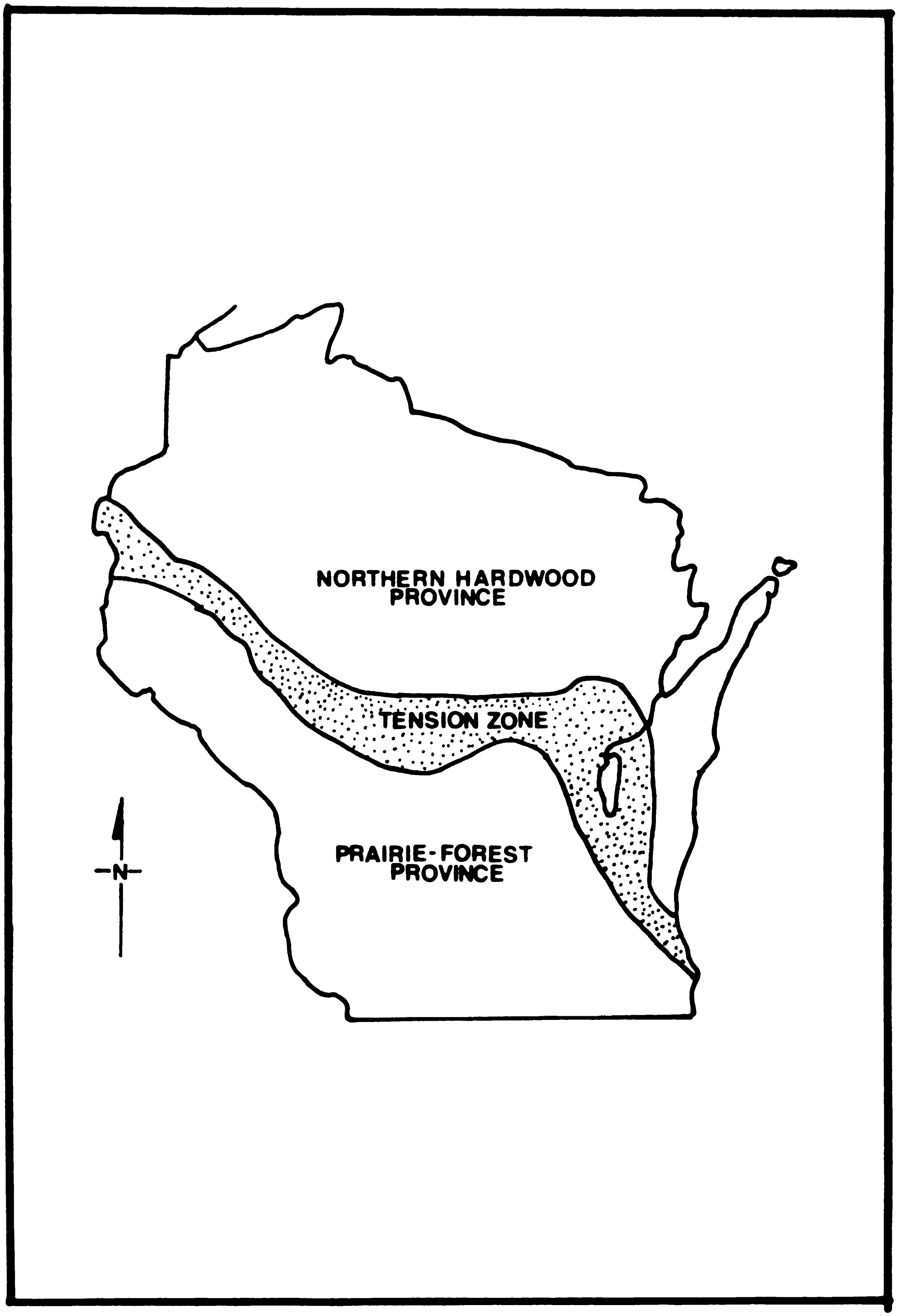

Figure 9 The Floristic Provinces of Wisconsin (Curtis 1959)

> "The tension zone separating major forest regions today has apparently been operative throughout postglacial times, with a maximum northward displacement of 40-60 miles during the Xerothermic period some 3500 years ago. North of the zone, the disturbance forest was pine and oak; south of it, the forest was oak and savanna." (Curtis 1959:455).

An important factor in Curtis' (1959) model is the intentional or unintentional fires which occurred in the State of Wisconsin following the last major glaciation. According to Curtis, "the oak openings, sand, oak, and pine barrend, bracken-grasslands, true prairie, fern, sedge meadow, shrub communities, and pine forest all owe their origin or maintenance to the repeated presence of fire" (Curtis 1959:461). The presence of fire and its relationship to the prehistoric population of the Sauer Resort site will be discussed in the following section dealing with the individual plant communities surrounding the Sauer Resort site.

Cleland (1966), argues that this tension zone is evident based upon faunal, as well as floristic information. This tension zone may be viewed as a transitional zone containing both plant and animal species from both the Canadian and Carolinian biotic provinces. Whereas Dice (1943) maintained that the Illinoian province extended up to the Canadian province, Cleland (1966) argues that prehistorically the Illinoian province extended further northeast than illustrated by Dice (1943). However, between the Illinoian and Canadian provinces, Cleland (1966) places the Carolinian-Canadian transition zone (Figure 10). Important also is the relative length of growing season for these biotic provinces. Cleland (1966), citing Yarnell (1964), states that the Canadian province has a growing season (frost-free days) of between 80 and 140 days, the Carolinian province between 140 and 180 days, and the Illinoian province between 140 and 180 days. These climatic differences must be considered a factor incluencing the differing biotic provinces.

To both Cleland (1966) and Curtis (1959), the transition zone concept

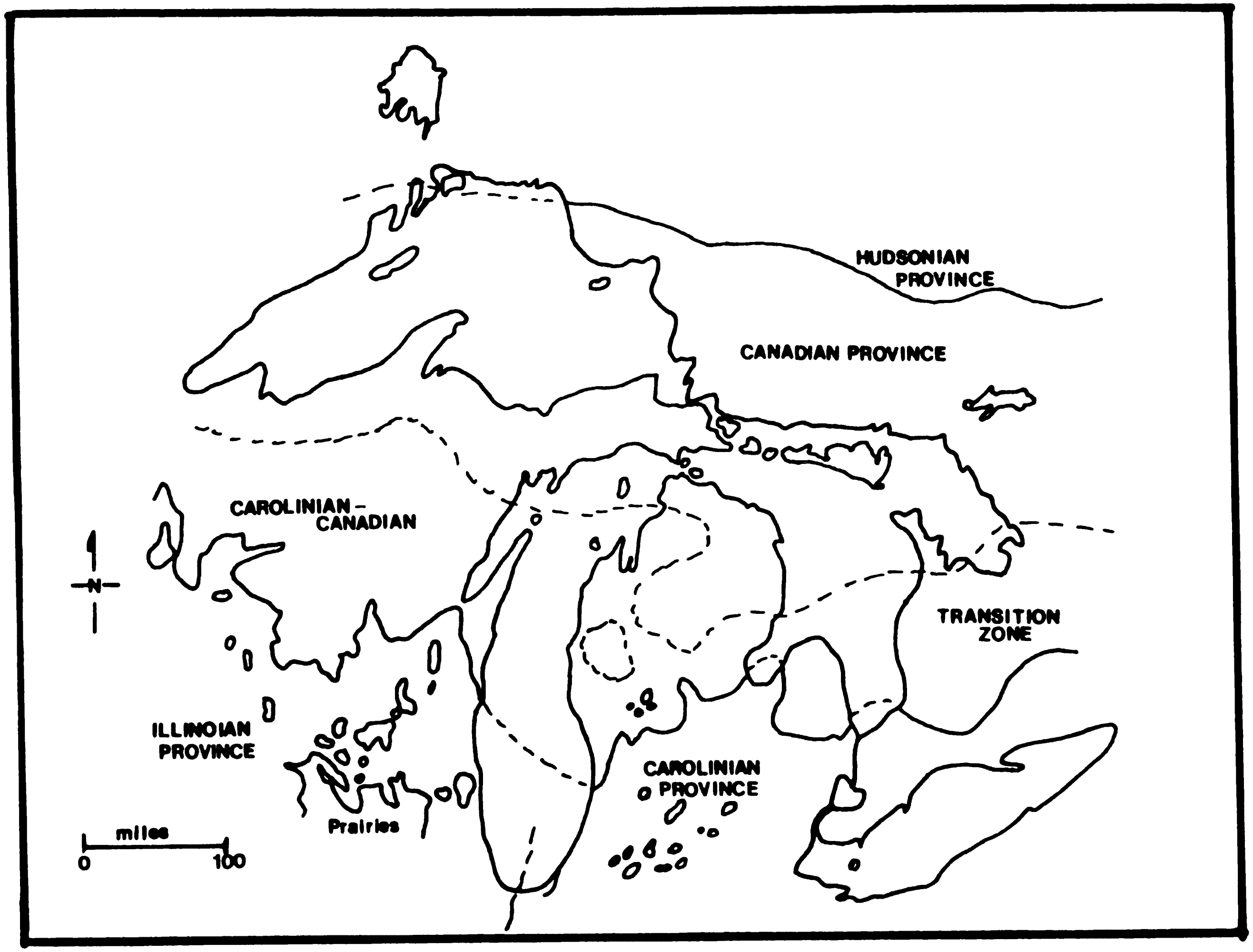

Figure 10 Biotic Provinces of the Great Lakes (After Cleland 1966:6)

represents an ecotypic orientation. As described in the opening section of this chapter, the natural community found between two biotic provinces has been referred to as an ecotone, edge or transitional zone. These communities may be gradual and difficult to define, or may be sharp and distinct, as in the case of the transition zone between the Canadian and Carolinian provinces (Cleland 1966:7). Since these communities vary in size, the archaeologist working in a particular area cannot assume that a site is located within an ecotone or tension zone. Because the Sauer Resort site and the Fox-Wolf drainage lie within the tension zone described by Cleland (1966) and Curtis (1959), it becomes incumbent upon the archaeologists working in this area to test the assumptions concerning floristic and biotic provinces. If in fact the Sauer Resort site is located in a transitional zone, the individual communities surrounding the site will be represented by plant and animal species (based upon historical and faunal analyses) from the Carolinian and Canadian biotic provinces. In the following discussion, these factors will be considered in depth for the individual plant communities surrounding the Sauer Resort site. Based upon the information described in this section, the ecological orientation of this site may be compared with the ecological orientation of other Oneota sites.

The plant communities surrounding the Sauer Resort site exhibit a great deal of diversity in both type and number of plant species. It is the purpose of this description to illustrate these individual plant communities and to quantitatively reconstruct a regional vegetation pattern. Emphasis is placed on canopy, as well as understory species, with consideration of their relative number and importance to animal and human communities. This approach is chosen for two reasons. Primarily, the historical documentation for vegetation in Wisconsin was compiled by geo

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geologists and naturalists employing a quantitative approach. These early surveyors were interested in the relative number of dominant plant species, especially ones which could be economically utilized. Since this information provides the best data available for prehistoric reconstruction, it becomes necessary to adopt this approach. Secondly, this plant community approach based on the kind and relative number of plant species allows for a more localized description, which permits testing of the regional ecological assumptions described by Dice (1943), Curtis (1959) and Cleland (1966). While employing a quantitative approach, it is necessary to emphasize that historical records allow for the reconstruction of vegetation at a particular time (1840-1870 A.D.) and may not exactly represent the prehistoric condition. Vegetation changes by lumber activities had already altered a portion of the Fox-Wolf drainage at the time of these surveys, and they must be considered within a reconstruction.

Within the following plant community description a variety of historical and modern sources are used. Beginning with early floristic accounts of the State of Wisconsin, authors such as Lapham (1852, 1853) and Hale and Lapham (1860, 1861) document flora surveys for the entire State of Wisconsin. For the purpose of a site specific description, the works of Chamberlin (1877) and Curtis (1959) are related in depth. In the case of the aquatic community, additional historical and modern information is needed. Since these communities have been greatly affected by historic alteration and were of little concern to the early surveyors (i.e. Chamberlin 1877), other historical documentation such as, (Kelly and Northwood 1853 and Thwaites 1959) and modern impact studies (Belonger 1969 and Linde 1974) are vital. By describing the plant communities surrounding the Sauer Resort site, it is possible to infer which animals would be found in these plant communities. The habitat preferences of the various animal species found near the Sauer Resort site are described in Appendix B.

The earliest record of flora and vegetation in the State of Wisconsin began with a list of native flora by Lapham (1852, 1853) with additional surveys by Hale and Lapham (1860, 1861). In 1861, Hale and Lapham published a map of the State of Wisconsin illustrating the general geology, climatology and distribution of timber. As shown by this map, the northern section of the state was mostly pine, with a gradation of pines and hardwoods to oak openings and prairie. These vegetation bands roughly correspond to the microclimate differences found within the state. Although interesting from a general perspective, these early floral lists and map provide little information about localized plant communities.

In order to evaluate the plant communities surrounding the Sauer Resort site, some measure is needed to delineate the potentially exploitable areas of the site. For the purpose of this discussion, a circle is used. A circle represents a boundary which is equidistant from the site locus, thereby mitigating against an artificial bias of treating one microenvironment over another based upon the geometric configuration of the boundary. Two arbitrary concentric rings, one with a radius of five kilometers and the other with a radius of ten kilometers is drawn surrounding the Sauer Resort site. Microenvironments illustrated include the Swamp/Open Water group, Grass and Sedge group, Marsh and Conifer group, Prairie group, Oak group and Hardwood and Conifer group (Figure 11). These designations are derived from Chamberlin (1877), with modern designations by Curtis (1959) also described. Table 1 presents a quantitative assessment of the environs surrounding the site. Also described in this discussion is an agricultural community. This human-altered community is confined to the oak group here illustrated.

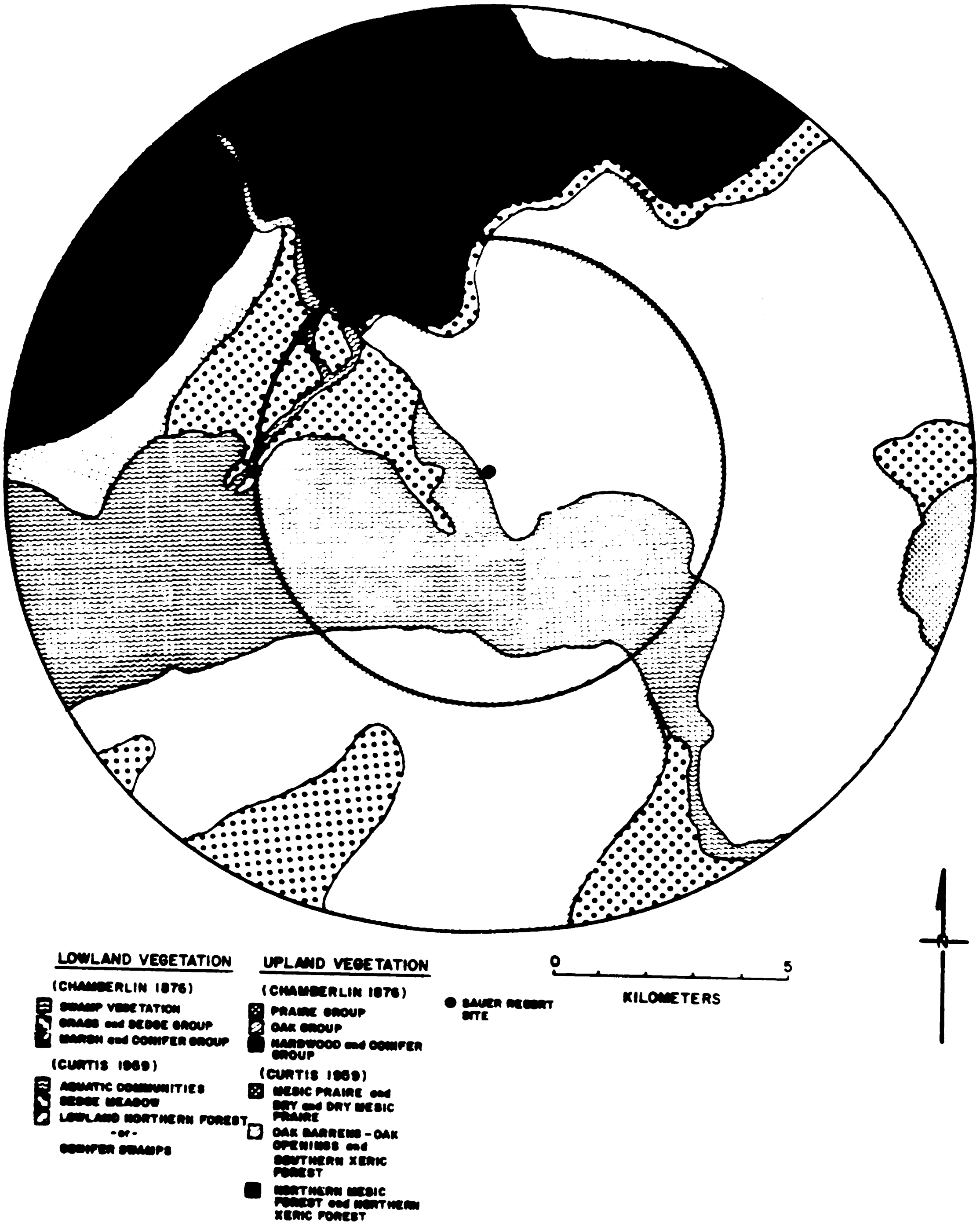

Figure 11 Microenvironments of the Sauer Resort Site

Table 1 A Quantitative Assessment of the Microenvironments Surrounding the Sauer Resort Site

	Vegetation Communities	Area (km^2) of community	% of Total Area within Concentric Ring
5 km Radius**	Hardwood and Conifer Group	3.43	4.4
	Grass and Sedge Group	7.88	10.1
	Swamp Group/Open Water	29.92	38.1
	Oak Group	37.15	47.4
10 km Radius*	Prairie Group	3.38	1.2
	Marsh and Conifer Group	10.80	3.5
	Grass and Sedge Group	34.24	10.9
	Swamp Group/Open Water	59.8	18.9
	Hardwood and Conifer Group	63.2	20.0
	Oak Group	144.2	45.5

*Total Area = 314.6 km^2

**Total Area = 78.65 km^2

Importantly however, the areas described within these concentric rings are not intended to infer that these are the limits of the areas exploited at the Sauer Resort site, but rather allow comparisons to be between the microenvironmental zones described here and the known habitats of the animals exploited at this site (Chapter III). Where possible, in the succeeding chapter inferences to distance of a particular resource is discussed.

For the purpose of clarity and the interrelationship of individual communities, lowland plant communities are discussed first, with upland plant communities to follow. Since individual communities grade into each other, this approach seems to most accurately describe the natural situation.

Swamp/Open Water Group

The Swamp group or Aquatic Community (Curtis 1959) may be defined as a plant community where the water table is above the soil layer for more than half the year. Open water areas are also found, but are restricted to the innermost portions of the mouth of the Wolf River and the current channel of Lake Poygan (Figure 4). Both of these aquatic conditions are potentially valuable to inhabitants of the Sauer Resort site. To varying degrees depending upon season, marsh-type areas are found throughout this community. Generally speaking, Lake Poygan in prehistoric times was a marsh with an open, herbaceous grouping dominated by cattails (Typha sp.), reeds (Scripus sp.) and other grass-like plants (Linde 1974).

Two major determinants affect the type of emergent and submergent plant species which grow in a particular lake or stream. The Wolf River, throughout its drainage leaches silicates from dolomite bedrock formations which causes the water of Lake Poygan to become relatively hard (high ppm of $CaCO_3$). Plant species that have a tolerance for relatively hard water flourish in this lake, while plants which are sensitive to hard water do not. Lake Poygan, in this regard is very similar to the majority of lakes in southern Wisconsin. The other important determiant is water level. Both emergent and submergent plant species have sensitivity to various levels of wtaer which control where they will be found.

Because of the disruption and destruction of the aquatic community during the 19th century and the lack of treatment in early surveys (Chamberlin 1877), it is difficult to document all the aquatic species found prehistorically. Reconstruction of this community is paramount however, since the aquatic community provides an important habitat for nesting water fowl and small mammals. Reconstruction of the aquatic community of Lake Poygan must largely be based upon modern environmental impact statements by Belonger (1969) and Linde (1974), with casual observations by Kelly and Northwood (1853) and Thwaites (1959).

Linde (1974) conducted a field survey of the submergents and emergents of Lake Poygan in the summer of 1973. Using Linde's (1974) findings and a 22 lake survey conducted by Belonger (1969), it is possible to describe 6 species of submergents and 7 species of emergents found in Lake Poygan. Since water hardness is constant factor within a lake such as Poygan, water levels become the only variable. Both emergent and submergent plant species, therefore, correspond to the documented water levels for Lake Poygan prior to historic damming. Refering again to Figure 7, the following plant species are found between the .2 m and 1.2 m depths: submergents, including, wild celery (*Valliseria americanus*), flat-stemmed pond-weed (*Potamogeton zosterifolius*); emergents, giant reed grass (*Phragmites australis*), duck potato (*Sagittaria latifolia*) and cattails (*Typha latifolia*). Between the 1.2 and 2.0 m level, the following species are found: submergents, coontail (Ceratophyllum demersum), bass weed (Potamogeton zosterifolius), sago pondweed (P. pectinatus), stoneworts (Chara sp.); emergents, wild rice (Zizania aquatica), rush (Scirpus acutus), bulrush (S. americanus) and pickerel weed (Potderia cordata). As is apparent from this placement, both emergents and submergents grade outward from the shoreline. As to be expected, all species (both emergent and submergent) begin in shallow water situations and move outward. It must be stressed here than many of the ecologically delicate species would have long been disturbed when these surveys (Belonger 1969) (Linde 1974) occurred. Many species of submergents such as those belonging to the genus Potamogeton (pond weeds) and Scirpus (bulrushes) and emergents such as Lemna sp. (duckweed) and Nuphar sp. (water lilies) would most probably have been found. However, it is impossible to state this with a great deal of certainty because of the general destruction of the aquatic community of Lake Poygan.

Grass and Sedge Group

The Grass and Sedge group or Sedge Meadow (Curtis 1959) for the most part are located in areas immediately adjacent to the emergent vegetation of the aquatic communities. Sedge meadows are found in areas where a good deal of water is available, but do not favor soils that are submerged for most of the growing season. In the central and southern sections of Wisconsin this plant community is also found in extinct glacial lake beds where areas are poorly drained (Curtis 1959). Both of these locational situations are evident surrounding the Sauer Resort site.

As the name of this group indicates, these meadows are largely composed of grasses (Gramineae), sedges (Cyperaceae) and importantly the family Compositae. Chamberlin (1877) identified the Gramineae and

Cyperaceae families, but did not include the Compositae in his original description. Modern surveys, such as those conducted by Curtis (1959) and his colleagues show that in the southern section of Wisconsin, Compositae represent 20.3%, Cyperaceae 8.1% and Gramineae 7.6%, with numerous other families representing a small percentage. Surrounding the Sauer Resort site, these plant species are restricted to a soil type known as Houghton Muck (Anderson et al. 1929). This soil type is characteristic of wet, poorly drained areas with an extremely high organic content. The large scale disintegration of the grasses and sedge combined with an aneorbic state, produces a layer of at least 18 inches (45.7 cm) of this soil in the Wolf River area.

As described previously, sedge meadows were created and maintained by the continual presence of fire. Fires intentionally set or accidentally produced would help to maintain this plant community in a retrogressive stage of development. It is possible that prehistorically when fires were more frequent, sedge meadows would have been much more visible than when Chamberlin (1877) conducted his survey.

Marsh and Conifer Group

The Marsh and Conifer group or Lowland Northern Forest (Curtis 1959) is found in close proximity to aquatic communities and sedge meadows. Chamberlin (1877) reserved this designation for a group of three tree species, tamarack (Larix laricina), black spruce (Picea mariana) and white cedar (Thuja occidentalis). Actually, the lowland northern forest is composed of two segments of a compositional gradient, the wet and the wet-mesic communities (Curtis 1959). These communities are composed of a water/slope continuum which includes the tamarack-black spruce bog forests, the white cedar-balsam fir conifer swamps, and the black ash-yellow birch-hemlock hardwood forests (Curtis 1959:221). Chamberlin

(1877) prefers to split these groups into the Marsh and Conifer group (tamarack, black spruce and white cedar) and the Hardwood and Conifer group (balsam fir, black ash, yellow birch and hemlock). The Hardwood and Conifer group will be discussed separately in a succeeding section.

The tamarack-white cedar-black spruce forests described by Chamberlin (1877) are located on the glacial lake bed and the adjacent flood plain. These areas are inundated by a mineral-rich silt on a seasonal basis. Consequently, these tree species enjoy a rapid growth and a predominant place in this plant community. According to Curtis (1959), in most cases these trees form a close canopy, which does not allow for the growth of many understory species. Since a very specialized environment is needed for these forests, they are restricted to small discrete bodies that rarely cover a great deal of area (Curtis 1959:222). Surrounding the Sauer Resort site, this plant community is restricted to small strips of land between the Grass and Sedge group and the Hardwood and Conifer group as well as between the Oak group and Hardwood and Conifer group. The soil type of the Marsh and Conifer group results from the glacial lake bottom and high organic content and has been referred to as Poygan silty clay loam and Houghton Muck (Anderson _et al_ 1929). With a continuous influence of fire, these species may be stunted producing a shrub-like community.

Prairie Group

The _Prairie Group_ defined by Chamberlin (1877) is the most difficult to describe using modern nomenclature. Although many early travelers, such as the Jesuits in the 1670's (Thwaites 1959), spoke of the majestic qualities of this plant community, little systematic study was undertaken until the 1950's. Because of this, the prairie group (Chamberlin 1877) may be divided into wet, wet-mesic, mesic, dry-mesic and dry prairie species. Each of these sub plant communities have differing percentages of plant species. The small area of prairie located 10 km due west of the Sauer Resort site was most probably a wet-wet-mesic prairie. These prairies include big blue stem (*Andropogon gerardi*), blue joint grass (*Calamagrostis canadensis*), sloughgrass (*Spartina pectinata*), wild rye (*Elymus canadensis*) and prairie muhly (*Muhlenbergia racemosa*) (Curtis 1959:285).

These prairies are restricted to areas where water is found on the soil surface during brief times of the year. The prairie associated with the Sauer Resort site is located adjacent to an area of sedge meadow. Oftentimes, the prairie species merge with the sedge meadows, making discrimination of each plant community difficult at the border between them. Since water conditions and slope are important to the development of these prairies, the soil type is largely described as Poygan silty clay loam (Anderson *et al* 1929). For the most part, the prairies surrounding the Sauer Resort site represent the furthest northern extension of this plant community.

The prairies of Wisconsin owe their creation and maintenance to periodic burn-over. The continued burning released nutrients back into the soils, thus allowing a large variety and density of herbaceous plant species to survive. Importantly, fire in the plant community constantly maintained it in a regressive stage. According to Curtis (1959), if the prairie regions of Southern Wisconsin had not been affected by fire, the deciduous forest species would have invaded the area occupied by the prairie species. As stressed earlier, it is impossible to discuss what natural plant communities in Wisconsin would have been if prehistoric humans had not interceeded. The specific effects of these actions however, cannot be fully known.

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Oak Group

The Oak group or oak barrens-oak openings and Southern Xeric Forest (Curtis 1959) is by far the largest single plant community surrounding the Sauer Resort site. The Oak group designation, according to Chamberlin (1877); includes closed deciduous forests (Southern Xeric Forests), as well as oak orchards or "openings". Closely associated with these oak openings are herbaceous plant species, with the resulting community referred to as oak savanna (Curtis 1959). It is important here to first describe the plant species found in the closed forest community and then to describe the oak savanna.

The predominate tree species of the Southern Xeric Forest include the bur oak (Quercus macrocarpa), the white oak (Q. alba), the red oak (Q. rubra) and pin oak (Q. palustris). Important associates of these oaks are the common poplar (Populus tremuloides), shell-bark hickory (Carya glabra), the crab apple (Pyrus coronaria), the wild black cherry (Prunus serotina), the choke cherry (P. virginiana) and the wild plum (Rhus typhina). Although the canopy species predominate in this community, significant understory species are also prevelant. These species include the hazelnut (Corylus americana), the panicled cornel (Cornus paniculata), the wild red raspberries (Rubus strigosus), the black raspberries (R. occidentalis) and high-bush blackberries (R. villosus). It must be stressed that the hazelnut and panicled cornel are the most common, with the berry species prefering other deciduous forest groups. The soil type of this community is predominately Poygan sandy loam (Anderson et al. 1929). This soil is thick (.92 m), well drained and fully developed. The parent material of this soil type is largely the blacio-fluvial beach sand of Glacial Lake Oshkosh.

Grading into the closed oak forest is a unique plant community known as the oak savanna. Oak savannas are often found as intermediate communities between the closed canopy forest and the herbaceous open prairie. According to Curtis (1959), many early explorers (i.e. Charlevoix 1761) spoke of this group as incorporating both large trees surrounded by grasslands. Two types of these oak orchards exist in the State of Wisconsin. The black oak openings are confined to the sandy regions, with the bur oak openings being found in more developed (heavy) soil areas (Curtis 1959:329). The openings surrounding the Sauer Resort site are more characteristic of the bur oak distinction. With the bur oaks, mesic prairie species such as _Amphicarpa bracteata_, _Euphorbia corollata_, _Amorpha canescens_, _Galium boreale_, _Monarda fistulosa_, _Rosa_ sp., _Cornus racemosa_, _Corylus americana_, _Apocynum androsaemifolium_, and _Andropogon gerandi_ are found.

As is the case with other plant communities, the oak opening is created by fire. According to Curtis (1959) the bur oak and black oak are resistant to damage by fire. Because of this resistance, these species become the most predominant. Increased fire activity would have allowed this community to remain in this form. It is possible that the closed oak forest that Chamberlin (1877) documented surrounding the Sauer Resort site might have been much more open in prehistoric time. With the advent of farming in the early 1800's, fires were controlled and the successional development of the community may have begun. Since the surveys discussed by Chamberlin (1877) did not cover many years, it is impossible to state unequivocally that this occured.

Hardwood and Conifer Group

The _Hardwood and Conifer group_ or _Northern Mesic and Xeric Forests_ (Curtis 1959) is a transitional community between the northern and southern floristic provinces. This group includes hardwoods such as, the sugar maple (*Acer saccharinum*), the linden (*Tilia americana*), the white elm *Ulmus americana*), the ironwood (*Ostrya virginica*), hickory (*Carya alba*) and the beech (*Fagus ferruginea*) (Chamberlin 1877). Hardwood understory species include the witch hazel (*Hamamelis virginica*) and the mountain maple (*Acer spicatum*). The first conifers to be introduced are the white pine (*Pinus strobus*), the norway pine (*P. resinosa*), the hemlock (*Abies canadensis*) and the balsam fir (*A. balsamea*) (Chamberlin 1877:180).

This plant community represents an interesting transition from mesic to xeric conditions. Species such as the maples (*Acer* sp.), ironwood and linden are found in wetter, more developed soils, with the pines ultimately being found in hilly, sandy soils to the north. The white pine, characteristic of this group, is found in large stands near the head waters of the Wolf and was exploited to a large degree in the 1800's. The soil type of this group is Superior silt loam and Superior clay loam (Anderson *et al*. 1979). These soils are derived from glacio-fluvial and modern river processes.

The Agricultural Community

As observed at other Oneota sites in Wisconsin (i.e. Pipe site, Overstreet 1981), prehistoric inhabitants produced large agricultural fields in order to plant maize and other garden crops. This synthetic or human-made community is restricted to the upland oak savanna area. Adjacent to the Sauer Resort site are garden beds located 1.75 km west of the site (SW¼, NE¼, Section 31, Town of Winchester). These garden beds are identical to the ridge and furrow type as found at Lasley's Point (Peske 1966). Agricultural activity at all three of these sites seems to be restricted to the soil type, Poygan sand loam. This sandy loam could produce a good crop because of its development and drainage.

Importantly, the synthetic community created by these prehistoric inhabitants would greatly alter the natural plant community. According to Curtis (1959), prehistoric populations girdled trees with fire in order to clear the land for planting. These clearing activities produced not only field-like situations, but caused a regressive peripheral environment. In climax oak forests or oak savannas, this activity allowed associated species to become more prominent. Species such as the popular (Populus sp.) encroached upon the cultivated fields. This is particularily significant because it produces the phenomenon known as "edge effect". Browsing animals such as white-tailed deer (Odocoileus virginianus) would be attracted to this area. The importance of this community and the concept of "edge effect" will be dealt with in greater depth in the succeeding chapter (Chapter III).

Based upon the previous discussion, it is possible to argue that the Sauer Resort site is located in a transitional zone between the major floristic and biotic provinces of Wisconsin. This fact is demonstrated by the intersection and interaction of the southern plant communities such as the Mesic/Xeric Prairie, Southern Xeric Forest, Oak Forest and Openings, with northern plant communities such as the Northern Lowland Forest and Northern Mesic/Xeric Forests (Curtis 1959). Importantly, as suggested in the preceeding discussion of the individual plant communities, a gradient exists between individual communities producing a mosaic vegetation pattern. The multiplicity of these communities provide a variety of resources for the prehistoric inhabitants of the Sauer Resort site.

The transitional zone between the Canadian and Carolinian biotic provinces is only one of the considerations pertinent to the ecological orientation of the Sauer Resort site. Although it may be argued that the "ecotone" effect of this transition would produce an area with a greater density of resources than the individual biotic provinces themselves, equally critical to this discussion is the relationship between the upland forest-prairies and the lowland forest-aquatic (including vegetated and open water) areas. For example, within a five kilometer radius of the Sauer Resort site, aquatic habitats make up 48.2% of the total area, while within the ten kilometer radius this habitat comprises 33.3% of the total area. Since it is expectable that this site was located in a position to exploit both upland and aquatic areas, it is possible to argue that the fauna represented at this site should represent both an upland and aquatic adaptation. The strength of this assumption is tested in the succeeding chapter (III) which deals with the faunal analysis of the site.

CHAPTER III

FAUNAL EXPLOITATION

The identification and analysis of faunal remains uncovered from archaeological sites has long been recognized as a valuable indicator of subsistence practices and cultural affiliations. In the case of the Lake Winnebago phase Oneota, early writers such as Lawson (1902) referred to large mussel shell middens as characteristic of this cultural manifestation. Appreciating the significance and relationship between the exploitation of freshwater mussels and these people, Lawson (1902) entitled his article, "Clam Eaters and their Shell Heaps in Winnebago County". In the same sense, modern faunal analyses use the known habitats and behavioral characteristics of animal populations and predictable patterns of exploitation of these species to infer human subsistence practices. Faunal analysis although limited at various levels within the analysis, remains with palaeobotanical studies, the best analytical tool available for the reconstruction of past subsistence practices.

The 1978 excavation of the Sauer Resort site yielded a great quantity of well-preserved bone material. In total, 24,580 bone fragments were uncovered from 27.6 cubic meters of soil, with 5,942 specimens (24.2%) identified to the family, genus, or species level. All animal classes represented in this analysis are a complete sample, except for freshwater mussels (Pelecypoda) of which only a random sample was retained. A density of 891 fragments per cubic meter, coupled with an identification rate of 24.2% of the recovered bone fragments illustrates the favorable preservation conditions. As discussed previously (Chapter II), the soil matrix of the Sauer Resort site is of glacial origin, moderately acidic, allowing for rapid water percolation and leaching of organic materials. These agencies working in concert should have produced poor, rather than favorable preservation conditions. Apparently, however, this did not occur. By an accident of deposition, a large deposit of freshwater mussel shells formed a compact lens which capped most of the shell midden. The shell cap slowly released calcium carbonate ($CaCO_3$) through the soil matrix, mitigating the acidic effect of the downward percolation. In areas where the midden was not capped (Unit A), the preservation of the bone material is poor.

Using the extensive, well-preserved faunal assemblage of the 1978 excavation of the Sauer Resort site as a data base, the following chapter addresses the posited interpretive differences between Cleland's (1966) and Overstreet's (1978, 1981) models for Oneota subsistence practices, as they apply to the Sauer Resort site data. The question of ecological/environmental exploitation and economic orientation is stressed in the analysis of the Sauer Resort site because these factors are critical to evaluate these models.

Because every faunal analysis must be constructed particular to that data base and the problems in question, and since no two faunal assemblages are identical, the initial segment of this chapter describes the procedures used in the identification and interpretation of the animal species represented in the Sauer Resort site assemblage. In this segment, the methods of identification and the types of information gained by a faunal analysis are described. Critical to the problem orientation of this thesis, the determination of minimum number of individuals (MNI) and projected meat are also described. From a general interpretive perspective, a discussion of non-quantitative information, such as habitat reconstruction, seasonal availability, artifactual evidence, and ethnohistorical information are described. The second segment of this chapter presents a class by class discussion of the animal species represented at the site. Within these discussions, the initial section presents habitat reconstructions of animal species, particular to the environs surrounding the Sauer Resort site. Also valuable for determining exploitation potential, behavioral characteristics such as mating, molt, and availability (season) are also discussed. The second section of the class discussion illustrates the archaeological significance of the species represented in the assemblage. This analysis, particular to each animal class, discusses the importance of various species, season of exploitation, and the environs exploited during the annual round. The final segment of this chapter summarizes the interpretations of the animal species represented in the assemblage and determines the significance of the animal classes relative to the entire subsistence system. Combining species identifications and quantification with inferences based on habitat preferences, site seasonality, and ethnohistorical accounts regarding subsistence practices in eastern Wisconsin by historic groups, a probable statement of the subsistence practices of the inhabitants of the Sauer Resort site is defined.

Procedures for Identification and Interpretation

The identification of individual anatomical elements from the Sauer Resort site was greatly facilitated by the extensive zoological collections of the Michigan State University Museum (Appendix C). This large, comprehensive collection houses a great number of Great Lakes mammals and birds. The fish collections, although limited in comparison to the mammals and birds represented, proved adequate for the identification of the great quantity of fish elements found in the assemblage. All identifications were made, fortunately, using available animal skeletons.

For each identification, a variety of information was determined. The taxonomic level (family, genus, species, provenience, identification number, element, side, portion, age (juvenile to adult), means for determining age, natural as well as cultural modification, were all recorded where applicable. This information compiled for 5,942 identifications provides an extensive data base (Appendix C) from which to draw conclusions. Faunal remains provide important information regarding site seasonality, procurement strategies, and subsistence practices based upon the information collected. The information documented in this analysis is commensurate with faunal analysis described by Chaplin (1971), Smith (1975), and Styles (1981).

The quantification of the known data, based upon identification of various elements is particularly important to the overall problem orientation of this thesis. The determination of minimum number of individuals (hereafter referred to as MNI) and the projected meat yield (pounds of usable meat) for each species is critical to the comparison of the data from the Sauer Resort site and other Oneota sites.

The MNI for each species was determined using the "single-most-frequent-element" approach (Grayson 1978). For example, if left radii are the most frequent element found for the badger, the number of individual elements represented would determine the MNI. This method has certain limitations. As the term implies, the MNI for each species represents <u>at least</u> a certain number of individuals, but may represent many more. Osteometric analysis on archaeological and modern populations of white-tailed deer indicates that MNI determined by a single-most-frequent-element approach are often conservative (Martin 1983).

In some cases, the side of the individual cannot be determined. Therefore, the identified specimen may not be used to determine the MNI. Consequently, MNI's are often low in comparison to the total number of specimens identified (Overstreet 1981). Acknowledging these limitations, this technique was chosen because other authors such as Cleland (1966), Gibbon (1969) and Overstreet (1978, 1981) employ this approach and therefore, for the sake of comparison, this method was used here.

The calculation of projected meat yield provides a complex problem for the quantification of the exploited species. Since factors such as season of procurement, habitat, and sex, affect the size (live weight) of each individual, it is difficult to determine unequivocally the projected meat yield of each species. Where possible this author looked to published information (Cleland 1966; Smith 1975; Styles 1981) to determine the projected meat yield per individual far various species. When this was not possible, a formula similar to the ones employed by these authors, was used.

Initially the live weights of each species was determined. In cases where sexual dimorphism produces greatly varied weights, the live weight of each species was translated into projected meat yield. This was accomplished by using a scaling factor of .5 (50%) for large mammals, .7 (70%) for birds, .2 (20%) for turtles, and .8 (80%) for fish. These factors are consistent with the calculations made by Cleland (1966) and Overstreet (1981). This scaling will facilitate the comparison of data from various sites in the following chapter.

Quantification of exploited resources presents only a part of the information needed to reconstruct past subsistence practices. In order to evaluate the importance of individual animal species represented in the archaeological assemblage, it is valuable to place these species into the environmental contexts from which they were extracted. Habitat reconstructions, based upon the environmental data outlined in Chapter II, combined with archaeological identifications, presents a more illustrative description of which environs are being exploited at the Sauer Resort site. Including behavioral characteristics such as species densities, season of availability (ie. hibernation and migration), mating, molt, and spawning runs where applicable, these reconstructions may also be viewed as scenerios of potential exploitation. This allows comparisons to be made between what resources are available and what resources are exploited, based upon the archaeological evidence.

Artifactual evidence in the form of procurement devices are also valuable indicators of resource utilization. Given the overall preservation of materials at the Sauer Resort site, various artifacts such as antler tine points, pelecypod fishing lures, and maize hoes, were uncovered. Although important from a procurement perspective, the artifacts also demonstrate that animals represented at this site were not only used for food, but as raw materials for tools and other implements. The significance of these artifacts is integrated into the faunal analysis where applicable.

Because of the temporal position of the Lake Winnebago phase Oneota in the prehistoric continuum, ethnohistorical documentation becomes an important source of information. Subsistence practices of historic groups, such as the Menominee, Fox, and Winnebago, as described by French Jesuits in the Jesuit Relations and Allied Documents (Thwaites 1959) becomes a valuable comparative tool. Throughout this analysis, historical procurement strategies and subsistence practices are discussed, relative to the archaeologically derived data.

The ethnographic literature is also used as a model to help to explain aspects of the reconstructed diet. Radin's 1923 study *The Winnebago Tribe* was conducted among Winnebago people some of whom lived in villages in the immediate area of the Sauer Resort site in historic times.

CLASS MAMMALIA

Mammals

Peoples of the Sauer Resort site made extensive use of the abundant mammalian fauna surrounding the site. A total of 5,660 well-preserved mammal fragments were identified, with 653 specimens being identified to family, genus, or species, representing at least 23 species. The following discussion of animal habitats particular to the Sauer Resort site incorporates the environmental information discussed in Chapter II with the identified mammal species. Table 2 illustrates the identified mammal species, grouped according to their general habitat preferences. The genus *Canis* sp. and the species *Bison bison* are not included in this discussion. The reason for this omission is explained in the succeeding section which deals with the archaeological significance of the mammal species represented in the assemblage.

The following discussion considers each mammal species identified at the site (except *Canis* sp. and *Bison bison*) in terms of their preferred habitat in order to understand general ecological regions exploited by the Sauer Resort site inhabitants. Within each ecological group, species are described in an order that corresponds to the number of specimens identified (Table 2).

Behavioral and Habitat Characteristics of the Represented Mammal Species

The habitat and behavioral characteristics of the white-tailed deer populations of the Great Lakes region have been extensively studied by modern ecologists and mammalogists (Baker 1983). Comparisons among these

Table 2 Identified Mammalian Species of the Sauer Resort Site

UPLAND SPECIES

SPECIES	# of Specimens Identified to order or lower zoological taxa	% of total mammalian specimens identified to order or lower zoological taxa
Odocoileus virginianus White-tailed deer	414	63.5
Cervus canadensis Elk or Wapiti	23	3.5
**Canis* sp. Dog/Wolf	19	2.9
**Microtus* sp.	17	2.6
Microtus pennsylvanicus Meadow vole	15	2.3
Tamias striatus Eastern chipmunk	10	1.5
Marmota monax Woodchuck	9	1.4
**Bison bison* American bison	4	0.6
Citellus tridecemlineatus Thirteen-lined ground squirrel	3	0.5
Taxidea taxus Badger	2	0.3
Martes americana Marten	2	0.3
Microtus ochrogaster Prairie vole	2	0.3
**Sciurus* sp.	1	0.2
Soricidae	1	0.2

Table 2 Continued

	SPECIES	# of Specimens Identified to order or lower zoological taxa	% of total mammalian specimens identified to order or lower zoological taxa
UPLAND & NEAR AQUATIC SPECIES	*Procyon lotor* Raccoon	47	7.2
	Mephitis mephitis Striped skunk	1	0.2
	Ursus americanus Black bear	1	0.2
	Subtotal Upland and Upland/Near Aquatic	571	87.7
AQUATIC SPECIES	*Ondatra zibethicus* Muskrat	53	8.1
	Castor canadensis Beaver	22	3.4
	Mustela vison Mink	5	0.8
	Lutra canadensis Otter	1	0.2
	Subtotal Aquatic	81	12.5
	Total	652	100.2
	Misc. Identification	31	
	Unidentified Mammal fragments	4977	

*Habitat reconstruction not included

studies and inferences concerning prehistoric animal populations have been discussed by Brown and Cleland (1968), Smith (1975), and Styles (1981). In the vicinity of the Sauer Resort site, the habitats of the white-tailed deer would range with the seasons, remaining a year-round resident. In the spring, white-tailed deer would be found in the large sedge meadows and wet, wet-mesic prairies (Curtis 1959). Since these areas green more quickly than do the deciduous forests, sedge meadows and prairies would provide a much needed food supply after the long Wisconsin winter. Beginning in the early summer and continuing until late winter, the preferential habitat for the white-tailed deer would be the oak-hickory forests and the critical periphery or edge areas. In these areas, white-tailed deer browse on young aspen and yellow birch saplings. With the advent of fall, acorn mast becomes the predominent food resource until the winter snows bury them too deep for the animals to reach them (Jackson 1961, Smith 1975; Baker 1983).

At the Sauer Resort site, the ripening of maize in garden beds surrounding the site would provide a valuable supplement to the white-tailed deer diet. This is a time of extensive feeding because of the need to accumulate fat for the winter. Food resources, so plentiful in the late fall, become scarce in winter. For most of the winter (December to March), the staple food for the resident white-tailed deer population would be saplings (aspen and birch) and various types of tree bark. Depending upon the severity of the winter, many white-tailed deer are lost during this season. Jackson (1961) maintains that prehistoric white-tailed deer densities in Wisconsin varied depending upon the natural biome. He estimates that white-tailed deer populations in central and northern Wisconsin (Canadian Biotic Province) to be approximately 10 to 15 white-tailed deer per square mile, or 4 to 6 animals per square kilometer.

However, in the oak-maple forest (Carolinian Biotic Province) of central and southern Wisconsin, white-tailed deer densities may reach 20 to 50 animals per square mile, or 8 to 9 individuals per square kilometer (Jackson 1961:416). Because of the proximity of the Sauer Resort site to both of these biotic provinces and given the nature of the ecotone effect (both natural and synthetic), density estimates for white-tailed deer populations would most probably be closer to the density estimates of the Carolinian Biotic Province, than those of the Canadian Biotic Province.

Two other behavioral episodes are valuable to the exploitation of the white-tailed deer. The fall rut or mating season (October and November) signals a change in residency patterns of this species. Whereas mature does, their yearling female offspring, and fawns are found together in the spring and summer, they are joined by small groups (up to four individuals) of bucks during the mating period. They continue as a group until early spring (Baker 1983). Therefore, since fall is a time of greater density of animals per unit of area, and each individual would reach its maximum weight because of the abundant food supply, this period represents the time of greatest exploitation potential. As the year progresses, the potential for exploitation gradually decreases, with both does and bucks reaching their lowest annual body weight in early spring. This is also the time at which there is a change in residency pattern.

The habitat and behavior of the American elk or wapiti must be reconstructed because this species is extirpated from its prehistoric range (Jackson 1961; Baker 1983). Elk, like white-tailed deer, would have been found in sedge meadows, stabilized openings and aspen-hardwood cover during the spring and summer moving to lowland and upland hardwood conifer forest, and aspen-rich areas in the fall and winter (Baker 1983).

According to Baker (1983), open areas are never abandoned completely during any season of the year. These habitats were all available surrounding the Sauer Resort site.

The behavior of the elk is much different than the white-tailed deer. Whereas the white-tailed deer is quite solitary, the elk is highly sociable and is found in large herds (Jackson 1961; Baker 1983). Although maintaining an aggregation throughout the entire year, the number and composition varies with season. Elk, like white-tailed deer, ruts in the fall. Because elk populations would reach their greatest annual body weight and their largest aggregation in the fall, this season must be considered the most preferential for exploitation.

Meadow voles are confined to areas of wet-mesic prairie, sedge, rush, and grass areas (Jackson 1961). This species is quite niche sensitive and its presence in the assemblage suggests that these environmental characteristics were located near the site.

The eastern chipmunk, according to Dice (1943) is restricted almost entirely to the Carolinian Biotic Province. Surrounding the Sauer Resort site, this small rodent would be found in dense hardwood forest areas.

The woodchuck, like other upland species identified in the assemblage, would favor the oak openings of the Southern Xeric forest, which surround the Sauer Resort site. This species would also be found in close proximity to horticultural sites where synthetic edge areas would create secondary growth. Jackson (1961) notes a statewide density of 4 to 5 individuals per square mile, or 4 to 5 individuals per 2.6 square kilometers. The woodchuck is available during the spring, summer, and fall, going into hibernation in the winter (Burt 1957).

The thirteen-lined ground squirrel is a small squirrel that inhabits open grassland areas of the Southern Xeric forests. According to Burt (1957) and Baker (1983), these small rodents are very niche sensitive and are never found in dense, climax forest areas. In close proximity to the site, these animals would be found in oak openings and prairies (wet, wet-mesic prairie).

The badger is found in open grassland and prairie openings. Surrounding the Sauer Resort site, badgers would be found in upland prairie conditions in close proximity to areas of easy burrowing, such as the elevated beach formations found near the site. In favorable habitats as those described for this area, a density of one individual per 2-3 square miles or one individual per 5 to 7.8 square kilometers may be reached. The badger does not hibernate, remaining active through the entire year.

The marten is now extirpated from the dense spruce and pine forests of Wisconsin, therefore, their habitat must be reconstructed. The "pine" marten represents one of the few mammal species identified from the Sauer Resort site that prefers coniferous forest habitats over grasslands or deciduous forest. Because they prefer dry upland pine forests, the habitat surrounding the Sauer Resort site would not be favorable for this species. Reaching a density of only one individual per square mile, this species would represent an uncommon occurrence at the Sauer Resort site.

The prairie vole is confined to open herbaceous habitats, such as the true prairies of southern Wisconsin, preferring dryer more upland conditions than the meadow vole.

The identification of the genus Sciurus (squirrels) and the family Soricidae (shrews) are also noted. Because these identifications could only be taken to the genus and family levels respectively, their habitat sensitivity cannot be determined.

Omnivorous species such as the raccoon would find many preferential habitats surrounding the Sauer Resort site. Preferring oak and conifer forests for denning and food supply, the prehistoric upland forests circling Lake Poygon would provide desirable habitat for the raccoon. According to Steuwer's (1943) studies of raccoons in Michigan, upland forests in close proximity to water supplies are most suited to this species (Baker 1983:445). Feeding on large amounts of freshwater mussels, amphibians, and fish, raccoons depend upon aquatic resources as well. Raccoons would also be drawn to human refuse areas as a feeding station and the Sauer Resort site was probably no exception. Excluding human-made environments such as middens, densities of animals would be approximately 40 to 50 animals per square mile, or 15 to 20 individuals per square kilometer in environs such as those surrounding the Sauer Resort site. Jackson (1961) claims that as many as one hundred individuals per square mile is not uncommon. Reaching their maximum annual weight and best pelt quality in November and December, this may be considered the period most favorable for utilization; however, raccoons unlike some other mammals do not hibernate and would be available through the year.

The striped skunk is a commonly occurring carnivore in Wisconsin. Exploiting a variety of habitats and food resources, skunks reach a density of one hundred or more individuals per square mile (2.6 square kilometers), with their lowest density of sixty individuals per square mile being reached in the winter. Skunks, like raccoons, are also attracted to human refuse areas.

The Southern Xeric forest, a favorable habitat for the black bear, would be found near the Sauer Resort site. Marsh and sedge areas associated with these hardwood forests, as well as garbage middens, would also have been attractive to a lesser degree. According to Baker, the combination of forested uplands and marsh/swamp areas provide sufficient food and cover for these animals (Baker 1983:433). The preferential season of exploitation would range from late summer to late fall because of factors such as body weight and availability.

The muskrat, a large microtine, would enjoy a favorable habitat in the Fox-Wolf drainage. As described in Chapter II, the average depth of Lake Poygon is between four and nine feet with a slow-moving current. This is critical because the current prevents the lake from freezing to the bottom, allowing winter movement to take place. Of the favorite foods described by Baker (1983:327), cattails (Typha), bullrush (Scirpus), arrowhead (Saggitaria latifolia), and reed grass (Phragmites communis) were all found in large concentrations in Lake Poygan. Because of this great quantity of food, muskrats would be found in high density in this lake. Accustomed to crowding, the density of these animals could reach up to 35 individuals per acre, or 87 per hectare (Jackson 1961). These factors produce a rich local resource. The most favorable season for exploitation would be fall, when young are born, and movements of animals are restricted. This is also a time when pelt quality would reach its best condition.

The beaver, exploited by prehistoric populations in the upper Great Lakes, are restricted to slow-moving rivers or streams and inland lakes where large stands of soft woods are available. Near the Sauer Resort site, numerous feeder streams such as the Rat River would provide excellent habitat for the beaver. The Rat River is located approximately two miles (3.2 kilometers) north of the Sauer Resort site. According to the environmental reconstruction of this area, large stands of aspen, birch, and willow would have dotted the banks of this small, slow-moving stream. Because beavers are in need of extensive feeding territories, their density is rather small in comparison to other mammals. The most preferential season of exploitation would be in late fall when this species reaches its greatest body weight and pelt quality (Cleland, personal communication).

The mink, like other aquatic species, favors submergent and emergent rich marsh areas. This mustelid, known for its rich pelt, enjoys an extremely favorable habitat in the Fox-Wolf drainage. Mink live in close association with other aquatic species, such as the muskrat. Searching for fish, ducks, and the smaller muskrat along stream banks, the mink is an excellent swimmer (Jackson 1961). The mink is attractive in all seasons, with restrictive movements in very cold weather. The season best suited for exploitation is late fall, when the pelt would reach its best quality.

The otter, like the mink, is a species which enjoys both terrestrial and aquatic habitats. Otters prefer deep water environments in selected areas with prolific emergent growth. Therefore, the species would likely have lived near the Wolf River. Not impeded by snow or cold weather, the otter remains active throughout the year.

Archaeological Significance of the Class Mammalia

The mammal assemblage at the Sauer Resort site indicates the importance of this animal class. The recovery of 5,660 mammal fragments (23% of the total assemblage) provides a large data base from which to draw inferences concerning the exploitation of this class. Providing the greatest amounts of meat of any animal class represented, mammals were also valuable for such by-products as hides, bone, and antler which were necessary to the overall subsistence. Although the preservation of bone is excellent, butchering and processing techniques, such as the making of bone grease and marrow extraction, result in a mammalian assemblage which may be characterized as fragmentary with many small bone fragments less than five centimeters in length. Due to the fragmentary nature of the assemblage, only 653 specimens (12.1%) could be identified to the family, genus, or species level, with at least 23 species represented. Table 3 illustrates the identified mammalian species of the Sauer Resort site, hierarchically ranked according to meat yield. The following discussions of the archaeological significance of the mammal species follows this hierarchical ranking in an attempt to illustrate the importance of each species relative to the entire class. As a further evaluation of the frequency at which various mammals are represented at the site, Table 4 ranks the mammal species according to the minimum number of individuals represented.

The exploitation of white-tailed deer at the Sauer Resort site, as in the case of most prehistoric populations in eastern North America, occupies a predominent and critical position in the annual subsistence round. At this site, a total of 414 specimens (64% of identified mammal specimens) were identified as white-tailed deer; 50 different anatomical elements are represented (Appendix C). At least 14 different individuals are represented in the assemblage, with a projected meat yield of 1,190.0 pounds.

The extensive number of different anatomical elements identified for the white-tailed deer from the Sauer Resort site assemblage provides potentially valuable information for the reconstruction of seasonal exploitation patterns. Within this assemblage a total of 25 mandibles were identified as white-tailed deer. The deer mandible is a particularily informative element. Using an aging technique which examines the eruption and wear characteristics of the teeth, it is possible to determine within six months to a year the age of the individual animal. Based upon this

Table 3 Mammalian Fauna of the Sauer Resort site 47/WN/207 (Hierarchially Ranked According to Projected Meat Yield)

SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Odocoileus virginianus White-tailed deer	414	14	left mandible	1190.0	50.7
Cervus canadensis Elk or Wapiti	23	2	right mandible	650	27.7
cf. *Cervus canadensis*	5	-			
Ursus americanus Black bear	1	1	left astragalus	210.0	8.9
cf. *Ursus americanus*	1	-			
Castor canadensis Beaver	22	5	right $\overline{I}$	157.5	6.7
Procyon lotor Raccoon	47	3	left femur	52.5	2.2
cf. *Procyon lotor*	3	-			
Canis sp. Dog/Wolf	19	2	left $M\overline{I}$	30.0	1.3
cf. *Canis* sp.	6	-			
Taxidea taxus Badger	2	1	left radius	13.3	.6

Table 3 Continued

SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Lutra canadensis Otter	2	1	left radius	13.3	.6
Marmota monax Woodchuck	9	2	right femus	11.2	.5
Ondatra zibethicus Muskrat	53	4	left mandible	8.4	.4
Mephitis mephitis Striped skunk	1	1	right radius	4.9	.2
Martes americana Marten	2	2	right tibia	4.2	.2
Mustela vison Mink	5	2	right mandible	1.0	.04
cf. *Mustela vison*	1	-			
Citellus tridecemlineatus Thirteen-lined ground squirrel	3	2	left femur	.8	.05
cf. *Citellus tridecemlineatus*	5	-			
Tamias striatus Eastern chipmunk	10	3	left mandible	1.2	.05
Sciurus sp.	1	1	left mandible	.8	.03

Table 3 Continued

SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Microtus pennsylvanicus Meadow vole	15	6	right mandible	-	
Microtus ochrogaster Prairie vole	2	2	right mandible	-	
Microtus sp.	17	6	left mandible	-	
Soricidae Shrews	1	1	right mandible	-	
Bison bison Bison	4	2	left scapula		
cf. *Bison bison*	1	1			
**Sus scrofa* Pig	1	1	left humerus	-	
Homo sapien	8	1	left mandible	-	
Total Mammals	683	66		2348.4	100.0

*surface context

Table 4 Hierarchial Ranking of Exploited Mammalian Species (Subsistence Related) Based Upon Total MNI

SPECIES	MINIMUM NUMBER OF INDIVIDUALS	% OF TOTAL NUMBER OF MAMMAL MNI
White-tailed deer	14	34.15
Beaver	5	12.20
Muskrat	4	9.76
Raccoon	3	7.32
Dog/Wolf	2	4.88
Elk or Wapiti	2	4.88
Mink	2	4.88
Woodchuck	2	4.88
Marten	2	4.88
Black bear	1	2.44
Squirrels	1	2.44
Badger	1	2.44
Otter	1	2.44
Striped skunk	1	2.44
Total Number of Individuals	41	100.0

technique, 12 of the 25 specimens were aged. Eleven specimens were between 1.5 and 4.5 years of age at death. A single specimen represents a six month old individual at the time of death. The remaining 13 mandibles lacked teeth and the aging method could not be used. However, based upon the size and thickness of the bone cortex, all appear to represent mature adults. The sample of primarily adult individuals with only a single immature individual represents an interesting collection of data.

The identification of predominently adult individuals may provide evidence for season of exploitation. Whether exploited by collective means such as surrounds, or individual practices such as stalking, the apparent selection for adult individuals may indicate a fall hunting practice. Rutting activities during the fall would cause an aggregation of mature individuals. White-tailed deer also reach their highest body weight at this time, with the pelt quality being best as well. Not only providing the greatest amount of meat at this time, hides may also have been a consideration. According to Gramley (1977), hides were sought after by historic groups such as the Iroquois because of their need for clothing. Mature animals obviously would have the largest hides available from which to make clothing. It is apparent from the archaeological assemblage that bone from mature individuals were fabricated into scapula hoes, projectile points, and hide beamers (Victoria Dirst, personal communication). The identification of a six month old immature individual also supports the claim that fall hunting practices took place at this site. Born in early spring, this individual would be approximately six months old in fall.

The ratio of 414 identified specimens to only 14 represented individuals given an indication of the type of processing that occurred at the site. The identification of fifty different anatomical elements suggests that white-tailed deer were processed in close proximity to the Sauer Resort site. There is no indication that these animals were disarticulated at the kill site and portions brought back to the habitation site. Elements which would not be found in field cuts are prevalent in the assemblage. Phalanges, carpals, and vertebrae, all representing portions of little food value are found in great frequency at the site (Appendix C). The appearance of an assemblage that suggests field processing would not be expected. It has been argued that the habitat surrounding the Sauer Resort site, both synthetic and natural, would have supported dense deer populations and there would be little need to process kills away from the site.

The identification of elk or wapiti in the assemblage indicates that these large bodied cervids were exploited at the Sauer Resort site. A total of 23 specimens are identified as elk; five additional tentative identifications are also made. At least two elk individuals are represented. Of the identified specimens, only three individual elements gave any clue to the age of the animal at death. Two elements (scapula hoes) are identified as adult based on size. A single phalanx (secunda) of a small (immature?) individual was also identified. Given this data, it is not possible to state that elk were taken in any particular season. However, these animals, like the white-tailed deer, may have been taken in the fall because they form larger aggregations during the rut, reaching their largest body weight and best hide quality at this time. Providing an estimated 650 pounds of meat (2 individuals), this species must be considered an important resource. In addition, elk scapulae appear to have been used as corn hoes and hide scraping implements (Victoria Dirst, personal communication).

Many of the specimens identified as elk-wapiti, including an astragalus and numerous mandibles, show deep butchering marks. In addition, numerous metapodial fragments, carpals, and phalanges identified in the assemblage do not represent meat-yielding parts of the animal. Like the white-tailed deer, this may indicate the processing of these animals took place at the site.

In the Sauer Resort site assemblage, a single specimen (1 individual) was identified as belonging to black bear. Black bear, not only supplies a great amount meat in a single package, but could have provided a valuable hide. Radin, in his ethnographic study, describes bear hunting among the Winnebago as a late summer activity (Radin 1923:111). He describes the taking of numerous individuals during a single hunt. Given that only a single individual is represented in the assemblage, one might argue that the taking of this animal represents an individualistic or opportunisitc hunting at any time of the year.

A total of 22 specimens in the assemblage were identified as beaver, with at least five individuals represented. The estimated contribution of meat by these individuals is 157.5 pounds. Because the beaver is an excellent swimmer and would be difficult to take in the water, they were most probably taken on land or in their lodges. The Winnebago, according to Radin, made use of this exploitive technique (Radin 1923:110). Atuned to the habitats and behavioral characteristics of the beaver and otter, Winnebago hunters would dig traps and cover them with grass along winding creeks where the animals cross overland. Crossing between water areas, the beaver and otter would fall into the traps and were unable to get out. Not only contributing a good deal of meat, fine beaver pelts may also have been a valued resource. Since these animals reach their greatest body weight and pelt quality in late fall, it is possible that they were exploited at this time (Cleland, personal communication).

In the assemblage, 47 specimens were identified as belonging to raccoon, with at least three individuals represented. Three tentative identifications were also made. Smith's (1975) extensive comparisons between modern wildlife accounts and the presence of raccoon in Middle Mississippian sites in Missouri suggests that raccoons would have been killed near water during daylight hours. He maintains that the exploitation of raccoons during hours of darkness would have required the use of dogs. Using ethnohistoric accounts, Smith argues that late prehistoric populations did not use domestic dogs for hunting (Smith 1975:45). Based upon the large numbers of individuals found in the assemblages he analysed, Smith (1975) maintains that raccoon were hunted in late fall and winter when they reach their maximum annual weight and best pelt quality. The identification of only three individuals in the Sauer Resort site assemblage may indicate that these animals were taken on a opportunistic basis. It is possible that these opportunistic kills may have taken place near the site midden. Ethnohistorical accounts by Jesuits visiting the Fox-Wolf drainage also describe the opportunistic taking of raccoons by historic inhabitants (Thwaites 1959, vol. 54, 56). Because raccoons are available throughout the year, it is impossible with any degree of certainty to argue for a particular season of exploitation.

The presence of domestic dog or wolf (Canis sp.) is common in late prehistoric sites of the Great Lakes region. Identifications by Cleland (1966) and Lippold (1971) illustrate that these species are found at various Oneota and Woodland sites. The similarity of osteological characteristics among the various species of the genus Canis, and the small sample size (19 specimens, 2 individuals), negates the possibility of a species identification.

Based upon the archaeological evidence, it is possible to argue that Canis sp. was used as a food source. Of the 19 specimens identified, 4 specimens indicate definite cut or butchering marks. Cut marks on a mandible, ulna, tibia, and fibula indicate that the animal was purposefully disarticulated after death. Gashes running perpendicular to the ulnar shaft, also suggest carnivore activity. The ethnohistorical record documents the keeping of domestic dogs as pets and for food in many Great Lakes Indian groups and it is not unlikely that the identified Canis specimens do belong to domestic dogs (Thwaites 1959: 56:18, 62:75). This assumption must only be considered tentative, considering species identification could not be made. It is known that the historic Winnebago trapped wolves, but also kept and ate domestic dogs at feasts (Radin 1923:110, 329). Based on size, it is considered likely that the specimens identified as Canis sp. are domestic dogs; therefore, no habitat reconstruction was proposed because it may be misleading to assume a particular habitat was being utilized to secure this resource.

The identification of two specimens (one individual) representing the badger illustrates the minor role it plays as a food resource. Because they spend their time in close association with their extensive burrow network, they are difficult to exploit. Given their rather low population density in comparison to other terrestrial mammals, this animal most probably represents an opportunistic kill by hunters at the Sauer Resort site.

The presence of a single otter (one specimen identified) illustrates the minor role of this species. Known for traversing over land for great distances and given the capture technique described for procurement of the beaver, it is possible that this individual could have been taken in the same manner.

Within the Sauer Resort site assemblage, nine specimens were identified as woodchuck, and at least two individuals are represented. These two individuals would provide a small amount of meat (11.2 pounds). A third individual, nearly complete (40 identified specimens), was found at the base of a burrow during the excavation, and is considered intrusive. The large krotovina found in the west wall profile may have resulted from the burrowing activity of this animal (Appendix A). The woodchuck is available from spring through fall and it goes into true hibernation in the winter. Exploitation was probably opportunistic in nature.

In the assemblage, a total of 53 specimens, representing four individuals were identified as muskrat. Although a minor resource in terms of meat yield, muskrat pelts could also be used. It is surprising given the excellent habitat and the expected high density of these animals in the Fox-Wolf drainage in prehistoric times, that only three individuals are represented in the assemblage. The most preferential season for exploitation of this species is early fall because of body size, aggregation, and pelt quality. Although a tentative assumption, it is possible that other, more preferential resources would have been exploited during this season, with muskrat being taken when opportunity presented itself.

The identification of a single specimen (one individual) representing the striped skunk in the assemblage illustrates the minor role of this resource. Easily taken because of its slow-moving gait, the skunk, like the raccoon, would be attracted to human refuse areas. The identification of a single individual may indicate that the skunk was not a desirable food item, because of its malodorous scent characteristics. In fact, Radin states that skunk were not eaten among the historic Winnebago (1923:110).

The marten, represented by the identification of two specimens (two individuals) indicates a minor subsistence role for this species. It is possible that these individuals were not taken as a food resource, but only for their pelts. Given the extremely low density of this species (one individual per square mile) and the unfavorable habitat conditions in close proximity to the Sauer Resort site, these animals could be taken when the opportunity arose.

The identification of five specimens (two individuals) representing the mink indicates that this species was an insignificant meat resource, and may have been taken for their pelts. The exploitation of this species may have taken place in late summer and early fall, in order to take advantage of the fine pelt as well as meat. These animals were most probably taken near the water's edge.

It is interesting to note that the historic Winnebago considered the flesh of the mink, marten, and otter inedible and Radin records that these species were taboo (Radin 1923:115).

This identification of numerous small sciurids and microtines although not considered a food resource may give indications of past ecological conditions. Niche sensitivity of species such as the meadow and prairie vole, the thirteen-lined ground squirrel, and to a lesser extent the eastern chipmunk, may provide information on the vegetation communities surrounding the Sauer Resort site. Due to the burrowing activities of these species, and their likely intrusive context, one must be careful in assuming that these animal remains are temporally coeval with the occupation of the Sauer Resort site. The presence of the prairie vole, which is restricted to upland prairie conditions, however, does demonstrate that prairie conditions were found near the Sauer Resort site in the past. Since most of the prairie in this area of Wisconsin was destroyed in the past 100 years due to agricultural activities, it is possible to tentatively assume that the presence of this animal in the assemblage may indicate at least an historic context.

The presence of bison in the assemblage is based upon the identification of four specimens. Three bison elements are scapulae which are modified into garden hoes. These hoes show a great deal of polish and modification, and were discarded in the midden. The only non-modified specimen is a single lumbar vertebra. Some authors, such as Overstreet (1981) have suggested that the preponderence of a particular element indicates trade with other contiguous groups (ie. Woodland peoples) for a particular portion of the animal. This hypothesis may explain the occurrence of bison scapulae as the predominate element in the bison assemblage and may indicate that peoples of the Sauer Resort site were trading for bison scapulae to be used as garden hoes. Also, given the excellent preservation at the Sauer Resort site and the thickness of the bone cortex of bison remains, it is expectable that many other anatomical elements would be found if these animals were being used as food. The lack of diverse bison elements may be contrasted to the large and diverse assemblage that represents white-tailed deer and elk. Because it is tentatively concluded that bison may not have been used as a food resource at the Sauer Resort site, the habitat for this animal was not reconstructed.

Mammalian Fauna - Ecological Orientation and Seasonal Indications

It is possible based upon the represented mammalian fauna from the Sauer Resort site, to make general statements concerning the environmental areas exploited in pursuit of particular mammalian resources. Based on projected meat yield for the species identified, terrestrial upland species contribute 2,168.9 (94.2%) pounds of meat, while aquatic species contribued 179.5 (7.6%) pounds of meat. More specifically, cervids such as white-tailed deer and elk account for 1,840 (78.4%) pounds of the upland meat and beaver accounts for 157.5 (87.7%) pounds of the aquatic meat yield.

It is evident from these calculations that the upland areas are more widely exploited as a food resource than aquatic areas, in the mammalian assemblage.

Upland/near aquatic mammals such as the black bear, raccoon, and skunk which exploit marsh and lacustrine habitats, as well as upland environments modify the perspective. If meat yield for these near aquatic species are added to the meat yield of the aquatic species, a figure of 414.6 pounds of meat is indicated. Compared to the total projected mammalian meat yield of 2,348.4 pounds, the aquatic and near aquatic species comprise 19% of the total projected mammalian meat yield. By considering both the near aquatic and aquatic species together, a better indication of the importance of the aquatic environment may be observed.

In the analysis of the mammalian fauna from the Sauer Resort site, particular attention was paid to epiphyseal closure and tooth eruption as indications of the age of individual animals at the time of death. If age can be determined, it may be compared with the known breeding season of the various mammal species, in an attempt to determine the season of exploitation. This inference to season of exploitation based upon these criteria may only be used in cases when the identified animal is not skeletally mature. Unfortunately, the only immature individual identified in the mammalian assemblage was a single six month old white-tailed deer. This individual, and the further identification of mostly adult individuals may indicate a fall exploitation. Excluding the white-tailed deer represented, the preponderance of mature mammalian individuals in the assemblage, makes the determination of season of exploitation difficult because many mammal species are available throughout the year.

It is possible in some cases, based upon behavioral characteristics of mammal species (ie. body weight, mating, and pelt/hide quality) and ethnohistorical accounts of exploitation practices to project the likely season of exploitation. These projected seasons of exploitation should be considered more tentative than the determinations based upon the archaeological assemblage. Using the before-mentioned criteria, Figure 12 illustrates the projected season of exploitation of various mammal species in the assemblage.

CLASS PISCES

Fish

The recovery of numerous fish specimens from the 1978 excavation of the Sauer Resort site indicates the importance of this class to the overall subsistence practice at the site. A total of 16,063 specimens (65% of the total specimens uncovered) were identified as fish, with 3,851 (24%) of the specimens identified to the family, genus, or species level. The remaining 76%, of 12,211 specimens were unidentifiable cranial, vertebra, and other post-cranial elements. The identification of the large fish assemblage resulted in a total of nine genera and fourteen species (Table 5). The identified fish specimens are ranked in Table 5 by family with species ranked within each family fased upon the number of identified specimens. Family designations are valuable because they combine species of similar morphology and habitat characteristics. In considering behavioral characteristics and the archaeological significance of the fish species represented, the family level is used in most cases. Where generalizations cannot be made at the family level, a lower zoological taxa is discussed.

In the following discussions of the habitat and behavioral characteristics of the fish species represented in the assemblage, particular attention is paid to spawning season, spawning habitat, and season of availability, all relative to the Fox-Wolf drainage. By including this

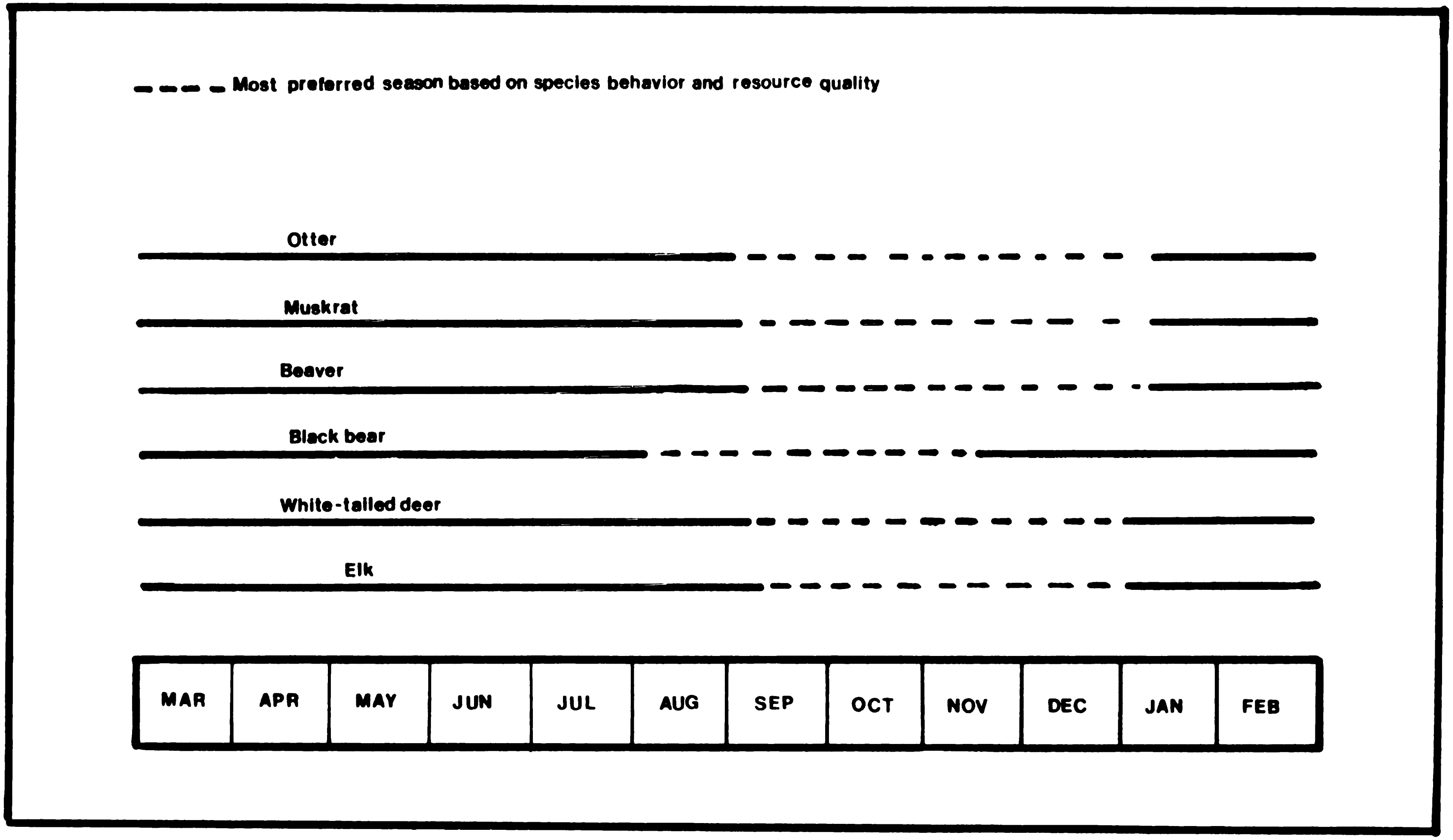


Figure 12 Projected Seasons of Exploitation of Selected Mammal Species

Table 5 Identified Fish Species of the Sauer Resort Site

FAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL FISH SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
Ictaluridae	*Ictalurus* sp. Catfish/Bullheads	765	19.80
	Ictalurus sp. Bullheads	285	7.40
	Ictalurus punctatus Channel catfish	259	6.70
	I. *natalis* or *nebulosus* Northern brown or yellow bullhead	50	1.30
	Ictalurus melas Northern black bullhead	24	0.60
	Pylodictis olivais Flathead catfish	1	0.03
	Subtotal Ictaluridae	1384	35.80
Percidae	*Stizostedios* sp. Walleye/Sauger	1015	26.22
	Perca flavescens Yellow perch	98	2.53
	Subtotal Percidae	1113	28.75
Centrarchidae	*Lepomis* sp. Sunfish/Bluegill	242	6.30
	Micropterus sp. Black bass	217	5.60
	Pomoxis sp. Carppie	90	2.32
	Centrarchidae sp.	47	1.20
	Ambloplites rupestris Northern rock bass	1	0.03

Table 5 Continued

FAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL FISH SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
	Subtotal Centrarchidae	597	15.42
Catostomidae	Moxostoma sp. Redhorse	210	5.42
	Ictiobus sp. Sucker/Buffalo	5	0.13
	Catostomidae sp.	5	0.13
	Hypentalium nigricans Northern hog sucker	2	0.05
	Catastomus comersonii White sucker	2	0.05
	Subtotal Catostomidae	224	5.80
Esocidae	Esox sp. Pike/Pickeral	114	2.90
	Esox lucius Northern pike	76	2.00
	Subtotal Esocidae	190	4.90
Amiidae	Amia calva Bowfin	165	4.30
	Subtotal Amiidae	165	2.30
Serranidae	Roccus chrysops White bass	75	1.90
	Subtotal Serranidae	75	1.90

Table 5 Continued

FAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL FISH SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
Acipenseridae	*Accipenser fulvescens* Lake sturgeon	66	1.70
	Subtotal Acipenseridae	66	1.70
Sciaenidae	*Aplodinotus grunniens* Freshwater drum/Sheephead	52	1.30
	Subtotal Sciaenidae	52	1.30
Lepisosteidae	*Lepisteus osseus* Longnose gar	4	0.10
	Subtotal Lepisosteidae	4	0.10
Hiodontidae	*Hiodon* sp. Goldeneye or mooneye	1	0.03
	Subtotal Hiodontidae	1	0.03
	Total Fish	3871	100.00

information in the discussion, it is possible in some cases to infer the location where the resource was extracted (ie. Lake Poygan or the Wolf River), by what means, and during which season the resource was most likely exploited.

Behavioral and Habitat Characteristics of the Represented Fish Species

The family Ictaluridae is a particularly homogenous family of related species. Including the species northern black bullhead, northern brown bullhead, northern yellow bullhead, channel catfish, and flathead catfish, the ictalurids share similar environments and behaviors. Feeding in turbid, often stagnent water on a variety of vegetation and insect larvae (mayfly in particular), ictalurids are bottom and surface feeders. The Fox-Wolf drainage is considered an excellent habitat for members of this family. Spawning in relatively warm water (77°F), reproductive activities would not begin until early June to late July in this drainage (Trippensee 1953). Not concentrating in large groups, ictalurids would be available throughout the ice-free season.

Walleye, sauger, and yellow perch represent the family Percidae in the assemblage. Spawning in large numbers in the Wolf River, walleye and sauger spawn in rather cold water in comparison to other species preferring waters of between 38° and 44°F (Trippensee 1953). Presently, spawning runs for these species begin in the Wolf River between late March and late April, depending upon the warmth of the particular year. These runs may last as long as six weeks (Hubbs and Lagler 1964). Yellow perch, like the walleye and sauger, spawn in spring in slightly warmer water of between 44° and 49°F (Trippensee 1953). In the Wolf River-Lake Poygan area, this occurs between the first of April and the first of May, roughly corresponding to the walleye/sauger run. Spawning activities would take place in the shallow waters of both the Wolf

River and Lake Poygan. Concentrated in large numbers during spawning, the yellow perch are a schooling species, with aggregates of individuals found together throughout the year. Feeding on a variety of foods, the yellow perch is available in any season.

The family Centrarchidae is represented by species of sunfish, bluefill, rock bass, crappie, smallmouth bass, and large mouth bass. Centrarchids feed upon a variety of foods and are most active during the ice-free months. Spawning takes place in warm water (59° - 65° F) between June and August. The smaller species such as sunfish, bluegill, and crappie often spawn in large numbers (Trippensee 1953). Producing many young, these species may reach densities of 25 pounds of fish per acre in favorable habitats, such as those found in the Fox Wolf drainage. Two larger species, the smallmouth and largemouth bass are also members of this family. The smallmouth bass prefers clear, swift streams or sandy-rock bottom lakes (Trippensee 1953). Given the prehistoric conditions of the lower Wolf River, this habitat can only be described as mediocre for this species. Spawning among the smallmouth bass takes place in river beds in warm water, during June and July. The largemouth bass, although morphologically similar to the smallmouth bass, enjoys fertile, muddy bottoms and the protection of emergent cover. Also spawning during the summer months, the largemouth bass is not as selective in its spawn practices, as the smallmouth bass. Given the habitat condition of the Fox-Wolf drainage, the largemouth bass would find excellent habitat.

Various species of the family Catostomidae are represented at the Sauer Resort site. This family is particularly homogenous with regard to species morphology, habitat, and reproductive characteristics and is represented by the redhorse, northern hog sucker, white sucker, and buffalo sucker. Like walleye and yellow perch, these species spawn in spring. Beginning to run when the water temperature reaches approximately 50°F, these species seek the rocky shoals of river banks and shallows of medium-sized lakes (Galloway 1976). In the case of the Fox-Wolf drainage, spawning would most likely take place in the Wolf River, rather than Lake Poygan. During spawning activities, these species are more active at night. Members of this family can inhabit areas of cold clear rivers, as well as warm turbid lakes. Depending upon season, both of these conditions exist in the Fox-Wolf drainage.

The family Esocidae, is represented by the northern pike and chain pickeral. Both of these species inhabit large cool pools in many northern rivers and lakes in the Great Lakes region, and are available throughout the year. Although active throughout the year, they are most active during the spring spawn. Sucking deep holes in rivers and lakes in order to deposit their eggs, spawning usually begins in April, coinciding with other spring running fish such as the catostomids and percids. Spawning activities would most likely take place in both Lake Poygan and the Wolf River. Given the ecological reconstruction of the Fox-Wolf drainage, the pike and pickeral would find excellent habitat.

The bowfin, representing the family Amiidae, is a large robust fish which was fairly common in the Great Lakes drainage system during prehistoric times (Hubbs and Lagler 1964). Preferring turbid, stagnant water, this species thrives in habitats where few other species can survive. The Fox-Wolf drainage may be considered as adequate environment. Spawning takes place at a high temperature (77°F) in mid summer (Slastenenko 1956).

The white bass represents the only member of the family Serranidae present in the lakes of Wisconsin. This species prefers large, open rivers with sand and gravel bottoms, such as those found in areas of the

Wolf River. Feeding on a variety of small fish, the white bass is most active during its spring spawning runs (Slastenenko 1958). Spawning begins when the water temperature reaches 60°F, corresponding to other spring spawning species. Both young and adults prefer to feed at night near the surface.

The family Acipenseridae, is represented by the lake sturgeon in the assemblage. A large-bodied species, the sturgeon spawns in the spring, seeking shallow waters such as those found in Lake Poygan. A slow maturing species, this species never obtains the density of other species (Hubbs and Lagler 1964). A bottom feeder, the lake sturgeon would find excellent habitat in the fertile bottoms of the Fox-Wolf drainage.

The freshwater drum or sheephead is the only fresh water species of a predominantly marine family (Sciaenidae). Preferring a mud or sandy bottom river or lake, this species spawns in spring, but does not concentrate in large numbers as previously described for other species (Hubbs and Lagler 1964). Although most active during spawning, this species is available through the ice-free season.

The long nose gar, representing the family Lepisosteidae, is an extremely predacious fish inhabiting the rivers and lakes of Wisconsin. Spawning begins in May or June in shallow waters among aquatic vegetation or on gravelly shoals (Hubbs and Lagler 1964). Large streams or rivers such as the Wolf are preferred spawning areas.

The family Hiodontidae, is represented by the mooneye or goldeneye. These species, like the bowfin and sturgeon, are primitive species of the Great Lakes region. Uncommon, these species feed on a variety of foods, spawning in spring in rivers such as the Wolf.

Archaeological Significance of the Class Pisces

In order to evaluate the significance of the fish assemblage at the

Sauer Resort site, a discussion of probable methods of capture is warranted. By examining means of capture, it is possible to hypothesize as to how various fish species were exploited as well as the most likely season of procurement. The following discussion draws upon archaeological and ethnohistorical evidence from the Great Lakes region, in particular Rostlund (1952) and Cleland (1982), ethnohistorical references particular to the Fox-Wolf drainage (Thwaites 1959) and artifactual evidence from the Sauer Resort site.

Various procurement techniques may have been used to exploit fish species at the Sauer Resort site. Capture techniques such as hook and line, harpooning, seine netting and the use of weirs may all have been used to exploit various species of fish at the Sauer Resort site. Rostlund (1952) first described the difference in exploitive techniques used by Indians on a regional basis, documenting the impact of various techniques on the subsistence practices of various groups. Recently, Cleland (1982) has documented ethnohistorically and archaeologically the evolution of exploitive technology for fish exploitation in open water areas of the Upper Great Lakes. According to Cleland's (1982) evolutionary scheme, individualistic capture devices such as spears and fish hooks appear in the archaeological record in the Late Archaic period (Cleland 1982:768). Beginning in the terminal Late Archaic and Early Woodland periods, evidence in the form of net sinkers appear in Great Lakes sites (Cleland 1982:769). During this time and proceeding through Middle and Late Woodland times, spears are replaced by harpoons and netting technology is further refined, with both seine and gill nets being used (Cleland 1982:773-74). Particular to eastern Wisconsin Oneota, Cleland (1982) cites the presence of net sinkers at the Mero site, on the shore of Green Bay (Cleland 1982:771). It is hypothesized here that similar technologies may have been used on inland lakes and streams.

Following Cleland's (1982) description of seine and gill netting technology, it is quite possible that seine netting would be employed in shallow water lakes and rivers, such as those found in the Fox-Wolf drainage. The seine net, according to Cleland (1982), is used to capture spring spawning species. He states:

> since many spring spawners in the shallow waters of lake shores are territorial and therefore dispersed, the most effective means of taking these species is with seines. These are deep, fine-meshed nets that are used to corral fish toward the shore. The effective use of the seine requires that it be kept tight to the lake bottom as it is moved through the water. To accomplish this, the bottom of the seine must be weighted with many closely spaced, tightly attached sinkers (Cleland 1982:774).

Ethnohistorical evidence for the use of nets for fishing the Fox River is described by Allouez in 1671-72. According to Allouez, nets were stretched across the Fox River (Thwaites 1959:56:121). These nets were used to procure fish, as well as migrating water fowl. He also describes the use of fish weirs as well. He states:

> It is a device that is somewhat rude, but excellently adapted to their prupose, and it enables a child to fish with great success. They construct it in such a manner as to bar the entire river from one bank to the other, making a sort of palisade of stakes, which they plant in the water in a straight line, leaving only space enough to allow the water to run between certain hurdles, which stop the large fish. Along this barrier they arrange scaffolds, on which they place themselves in ambush and await their prey with impatience. When the fish, following the current, reach this barrier, the fisher plunges in a pocket-shaped net, into which he easily coaxes them (Thwaites 1959:56:122-3).

Artifactual evidence from the Sauer Resort site, in regard to fishing devices is meager. Overstreet (1981) has also described a similar situation at the Pipe site. Evidence of the material culture associated with fishing technology at the Sauer Resort site is limited to numerous carved pelecypod lures and possible netting needles. Absent from the assemblage are harpoon heads, gorges, or net sinkers. This is, however, not surprising given the location of the Sauer Resort site relative to the Wolf River. Since people from the site would be moving approximately three miles to the waters of the Wolf River, it is unlikely that they would carry large numbers of net sinkers back to the habitation site. Rather, netsinkers may have been cached near the fishing site to be retrieved for later use. It is also possible that unmodified pebbles were used as net sinkers, and discerning these weights as artifacts would be very difficult. Therefore, the lack of netsinkers in the assemblage does not necessarily indicate that nets were not used. Harpoons and hooks and lines may also have been used, and discarded away from the habitation site. Based upon these assumptions the importance of the various fish species in the assemblage are described here.

In Table 6, the identified fish species in the assemblage are hierarchically ranked according to their meat contribution by family. Within each family, genera and species are further ranked according to meat yield. In the total fish assemblage, 3871 specimens are identified with at least 427 individuals represented. The projected meat yield for these 427 individuals is 834.1 pounds, ranking second only to mammals in total projected meat yield. As a further indication of the distribution of the various identified fish species, Table 7 hierarchically ranks the fish families by minimum number of individuals, with genera and species ranked within each family also based on minimum number of individuals.

The family Percidae represents the largest meat contribution of any family in the fish assemblage. The identification of 108 individuals is noted. The projected meat yield based upon these individuals is 417.2 pounds, which represents 50% of the total projected fish meat yield. By far the greatest number of individuals represented in this family is the walleye and sauger. The identification of 1,015 specimens (26% of total

Table 6 Fish (Osteichthytes) Fauna of the Sauer Resort site 47/WN/207

FAMILY	SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Percidae	*Stizostedion* sp Walleye/Sauger	1015	85	left dentary	408.0	49.0
	Perca flavescens Yellow perch	98	23	left operculum	9.2	1.1
	Subtotal Percidae	1113	108		417.2	50.1
Ictaluridae	*Ictalurus punctatus* Channel catfish	259	31	left operculum	99.2	11.9
	Ictalurus sp. Bullhead	285	91	left dentary	54.6	6.5
	I. natalis or *nebulosus* Northern brown or Yellow bullhead	50	14	left operculum	8.4	1.0
	Ictalurus melas Northern black bullhead	24	8	right coracoid	4.8	.6
	Pylodictis olivais Flathead catfish	1	1	right ceratahyal	.5	.06
	Ictalurus sp. Catfish/Bullhead	765	-			
	Subtotal Ictaluridae	1384	145			

Table 6 Continued

FAMILY	SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Esocidae	Esox lucius Northern pike	76	16	right articular	71.6	8.5
	Esox sp. Pike/Pickeral	114	3	left celithrum	6.0	.7
	Subtotal Esocidae	190	19		77.0	9.2
Centrarchidae	Micropterus sp. Black bass	217	21	right dentary	42.0	5.0
	Lepomis sp. Sunfish/Bluegill	242	43	left preoperculum	17.2	2.1
	Pomoxis sp. Crappie	90	17	right cleithrum	6.3	.8
	Ambloplites rupestris Northern rock bass	1	1	left supracleithrum	2.0	.2
	Centrarchidae Sunfish/Bluegill	47	-			
	Subtotal Centrarchidae	597	82		68.0	8.1
Acipenseridae	Accipenser fulvescens Sturgeon	66	1	dermal plates	36.0	4.3
	Subtotal Acipenseridae	66	1		36.0	4.3

Table 6 Continued

FAMILY	SPECIES	SPECIMENS	MINIMUN NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Sciaenidae	*Aplodinotus grunniens* Freshwater drum/ Sheephead	52	7	right premaxilla	21	2.5
	Subtotal Sciaenidae	52	7		21.0	2.5
Catostomidae	*Moxostoma* sp. Redhorse	210	34	left hyomandibular	13.6	1.6
	Ictiobus sp. Sucker	5	3	parasphenoid	3.6	.4
	Hypentalium nigricans Northern hog sucker	2	1	right quadrate	1.2	.1
	Catastomus commersonii White sucker	2	1	right maxilla	1.2	.1
	Catostomidae Buffalo/Redhorse/Sucker	5	-			
	Subtotal Catostomidae	224	39		19.6	2.2
Amiidae	*Amia calva* Bowfin	165	7	left operculum	14.0	1.7
	Subtotal Amiidae	165	7		14.0	1.7

Table 6 Continued

FAMILY	SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Serranidae	*Roccus chrysops* White bass	75	15	left quadrate	6.0	.7
	Subtotal Serranidae	75	15		6.0	.7
Lepisostcidae	*Lepisteus osseus* Longnose gar	4	3	left dentary	4.8	.6
	Subtotal Lepisosteidae	4	3		4.8	.6
Hiodontidae	Hiodon sp. Goldeneye or Mooneye	1	1	left dentary	3.0	.4
	Subtotal Hiodontidae	1	1		5.0	.4
	Total Fish	3871	427		834.1	99.9

Table 7 Hierarchial Ranking of Exploited Fish Species (Grouped by Family) Based Upon Total MNI

FAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF FISH MNI
Ictaluridae	*Ictalurus* sp. Bullheads	91	21.31
	Ictalurus punctatus Channel catfish	31	7.26
	I. natalis or *nebulosus* Northern brown or yellow bullhead	14	3.28
	Ictalurus melas Northern black bullhead	8	1.87
	Pylodictis olivais Flatheat catfish	1	0.23
	Subtotal Ictaluridae	145	33.95
Percidae	*Stizostedion* sp. Walleye/Sauder	85	19.91
	Perca flavescens Yellow perch	23	5.39
	Subtotal Percidae	108	25.30
Centrarchidae	*Lepomis* sp. Sunfish/Bluefill	43	10.07
	Micropterus sp. Black bass	21	4.92

Table 7 Continued

FAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF FISH MNI
	Pomoxis sp. Crappie	17	3.98
	Ambloplites rupestris Northern rock bass	1	0.23
	Subtotal Centrarchidae	82	19.20
Catostomidae	*Moxostoma* sp. Redhorse	34	7.96
	Ictiobus sp. Sucker	3	0.70
	Catostomus commersonii White sucker	1	0.23
	Hypentalium nigricans Northern hog sucker	1	0.23
	Subtotal Catostomidae	39	9.12
Esocidae	*Esox lucius* Northern pike	16	3.75
	Esox sp. Pike/Pickeral	3	0.70
	Subtotal Esocidae	19	4.45

Table 7 Continued

FAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF FISH MNI
Serranidae	*Roccus chrysops* White bass	15	3.51
	Subtotal Serranidae	15	3.51
Amiidae	*Amia calva* Bowfin	7	1.64
	Subtotal Amiidae	7	1.64
Sciaenidae	*Aplodinotus grunniens* Freshwater drum/Sheephead	7	1.64
	Subtotal Sciaenidae	7	1.64
Lepisosteidae	*Lepisteus osseus* Longnose gar	3	0.70
	Subtotal Lepisosteidae	3	0.70
Acipenseridae	*Accipenser fulvescens* Sturgeon	1	0.23
	Subtotal Acipenseridae	1	0.23

Table 7 Continued

FAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF FISH MNI
Hiodontidae	*Hiodon* sp. Mooneye or Goldeneye	1	0.23
	Subtotal Hiodontidae	1	0.23
	Total Fish MNI	427	100.00

identified fish specimens) with at least 85 individuals recognized is an indication of the value of these species. Although it is morphologically impossible to separate walleye (*Stizostedion vitreum*) from sauger (*Stizostedion canadense*) using osteological evidence, based on modern occurrence of both these species in Wisconsin rivers, the majority of the individuals represented in the assemblage is most probably walleye. This may be considered a rather moot point because both species share similar habitats and behavioral practices and would most probably be treated in the same way by the inhabitants of the Sauer Resort site.

The yellow perch, a percid like the walleye and sauger, is represented by 98 identified specimens with at least 23 individuals represented. Considerably smaller than the walleye, yellow perch account for only 9.2 pounds of meat.

The exploitation of the walleye, sauger, and yellow perch at the Sauer Resort site was most probably a spring activity. These species represent early spring spawning species, which would begin to run in the Wolf River in March or early April. The most likely means of capture would be seine nets or the use of a fish weir. Given the rather large number of individuals in comparison to other species, it seems likely that a collective technique such as netting or the use of a weir would be used, rather than a more individualistic technique. Osteometric determinations of size based upon selective elements may also give indication of how these resources were exploited.

In the fish assemblage, a total of 1384 specimens, representing 145 individuals were identified to the family Ictaluridae. A total of 5 species were identified, ranging in size from the large channel catfish to the small yellow and brown bullheads. Together these species contribute 167.5 pounds of meat and rank second to the family Percidae.

The exploitation of catfish and bullheads could take a variety of forms. Not concentrating in large groups as is the case with the percids, small ictalurids such as the northern black, brown and yellow bullheads, as well as small channel catfish, could be taken using seine nets or hook and line. Exploitation of large species such as the channel catfish would most probably have been harpooned. Identification of extremely large individuals based upon dentaries and articulars indicates that channel catfish as large as 30 pounds were exploited at the Sauer Resort site. Unfortunately, the exact weight of these large channel catfish individuals from the Sauer Resort site could not be calculated with precision, because no modern specimen even approaching this size is available for comparison. Based on the projected size of these individuals, it is quite possible that these individuals would be taken using a harpoon. Large channel catfish searching shallow water (4-6 feet) to spawn in late spring and early summer could be taken in this manner.

The most likely season of exploitation of ictalurid species would be during the summer months. Preferring warmer waters than other families, summer would be the best season for their procurement. Exploitation of these species could take place in both the Wolf River and Lake Poygan, with preferential habitats being found in both areas.

The presence of the family Esocidae in the assemblage is based upon the identification of 190 specimens to the genus Esox, with at least 19 individuals represented (77.0 pounds of meat). Two species belonging to this genus, the northern pike and chain pickeral, are found in large numbers in the lakes and rivers of the Great Lakes region. Often difficult to separate these species based upon osteological differences, it is possible based upon the size disparity between these species to argue that northern pike represent the largest number of the specimens identified.

Importantly also, these species enjoy similar habitats and were most probably treated in a similar manner by the occupants of the Sauer Resort site.

Spawning in both lakes and streams in late April, these species could have been taken with collective techniques such as netting, and may have been taken in concert with other spring spawning species. The northern pike and pickeral are also known to take a hook from spring through late summer (Trippensee 1953). Attracted to artificial bait, pelecypod fishing lures may have been used to attract and harpoon these species. The most probable season of exploitation of this species would be between early spring and late summer, although pike could have been caught in nets in the fall.

The identification of three genera and a single species belonging to the family Centrarchidae indicates that a variety of centrarchid species were exploited at the Sauer Resort site. A total of 597 specimens were identified in this family, with 380 specimens (63.7%) representing small panfish species such as bluegill, sunfish, northern rock bass and crappie. Sharing similar habitats, these species may have been treated as a single resource.

A variety of exploitive techniques may be used to procure these species. Using hook and line, these species could be taken in the greatest number during their spawning season (early summer). Although densities are the greatest during the summer months, all of these species will take a hook throughout the year. One possible exploitation for the rather large number of individuals (61 individuals) may be that these species were exploited using seine nets near the shores of Lake Poygan. Because of their small size, these panfish species comprise only 26.0 pounds of meat.

The identification of the genus *Micropterus* presents a problem in interpretation. A total of 217 specimens, representing 21 individuals, are identified to this genus. Two species, *Micropterus dolomieui* (smallmouth bass) and *Micropterus salmoides* (largemouth bass), although indistinguishable based upon skeletal morphology, are found in different habitats. It may be possible, using habitat preference, to suggest the probable species composition of this genus in the assemblage. Smallmouth bass, preferring clear, cold water habitats, would find less favorable habitat than the largemouth bass, which enjoys more fertile, muddy lakes and streams. The reconstruction of the aquatic ecology of the Fox-Wolf drainage during the time the Sauer Resort site was occupied suggests that largemouth bass would most probably be found in the greatest number in the assemblage.

The most likely season of procurement for these two species would be in spring. It is quite possible that netting activities or the use of weirs would trap these species along with other spring spawning species, such as walleye.

The importance of the fresh water sturgeon (family Acipenseridae) to prehistoric populations in the Great Lakes has often been described (Cleland 1966, 1982). This extremely large (often greater than 100 pounds) fish has been compared with large terrestrial species, such as the white-tailed deer, in terms of species yielding large amounts of meat. Identification and quantification of this species is often difficult because the skeleton is largely cartilaginous and, therefore, does not preserve well. As in the case of the specimens (66) represented in the Sauer Resort site assemblage, the dermal plates of the cranium are all that is preserved, and therefore the identification of a single individual may represent a conservative estimate. Often broken because of their brittleness, the plates do not serve as adequate elements for the determination of minimum number of individuals. Spawning in shallow waters in spring, the sturgeon was most probably taken with a harpoon, with a single individual representing a large amount of meat (projected meat yield 36 pounds).

The presence of the freshwater drum, or sheephead, is noted in the assemblage. A large freshwater species, they may obtain a weight of nearly 100 pounds (Hubbs and Lagler 1969). This species is well-known by the characteristic otolith, or inner ear bone, and triangular pharyngeal teeth. A total of seven individuals (52 specimens) were identified from the assemblage.

Spawning in spring, freshwater drum, like the ictalurids, do not concentrate in large numbers as previously described for other species and are available through the ice-free season. A variety of methods could be used to procure this species. Taking a hook well, this species could easily be procured in this manner. Overstreet (1981) argues that in Lake Winnebago this species could be taken using gill nets in deep water, because hooks and harpoons are absent from the Pipe site. Cleland's (1982) descriptions of gill nets indicate that gill nets are selective based upon the mesh size (Cleland 1982:776). In order to evaluate Overstreet's (1981) claim, additional information is needed. Weight and size of freshwater drum may be determined from otolith measurements, and if the size of the individuals were relatively similar, additional credance could be given to his claim (Cleland, personal communication). At the Sauer Resort site, the presence of seven individuals does not present a sample large enough to test these assumptions. It may only be inferred here that a variety of methods may have been used to procure the freshwater drum, with exploitation taking place during the ice-free season.

Various species of the family Catostomidae are represented by 39 individuals (224 specimens) in the assemblage. This family is particularly homogeneous with regard to species morphology, habitat and reproductive characteristics. In the assemblage, catostomids are represented by the genera Morostoma and Ictiobus, with species identifications being Hypentalium nigricans and Catastomus commersonii. It is quite possible that these species were exploited together, with inhabitants of the Sauer Resort site making little differentiation as to one species over another. The representation of any species in the assemblage, may be the result of the availability of particular species in any given year.

Buffalo, redhorse and suckers, like walleye and yellow perch, spawn in cold (50°F) spring waters. A variety of techniques, such as nets (in concert with other species taken) and harpoons, may have been used. Most active at twilight, catostomids could be easily taken using individualistic techniques, such as harpooning. Contributing only 19.6 pounds of meat, this is a minor resource in comparison to other spring species.

The bowfin, or dogfish, is a large, robust fish: its usual skeletal morphology makes it an easy species to identify. Because of its unusual skeletal morphology, zooarchaeologists such as Parmalee (in Winters 1969) argue that the importance of the bowfin may be overstated in the analysis of faunal remains from archaeological sites. This is entirely possible. The historic Winnebago considered the dogfish to be inedible (Radin 1923:115).

In the assemblage, a total of 165 specimens were identified as bowfin, with seven individuals represented. The projected meat yield of the seven individuals is 14.0 pounds. A warm water spawner (77°F),the bowfin could be taken with a hook and line or in seines with other fish such as the ictalurids.

The white bass, a spring spawning species, is represented by 75 specimens (15 individuals) in the assemblage. The total projected meat yield of the species is 6.0 pounds. The exploitation of the species was most probably in spring, in association with other spring spawning species.

The longnose gar is identified in the assemblage by the characteristic dentaries of this species. The identification of 4 specimens (3 individuals) indicates that it was a minor fish resource. Based upon the size of the dentaries in the assemblage, these individuals were large (greater than 4 feet) and were most likely harpooned during their spring spawning activities.

The identification of a single dentary of the mooneye, or goldeneye (Hiodon sp.) represents an uncommon species in the Great Lakes region. The individual represented in the assemblage is quite small and most probably taken in seines with other spring spawning species.

Fish Fauna - Seasonal Indications and Areas of Exploitation

The exploitation of various fish species at the Sauer Resort site provides valuable information concerning site seasonality. As described through the previous discussion, the majority of fish species in the assemblage are spring spawning species, probably indicating that the site was occupied during that time of year in order to exploit this important resource. Figure 13 illustrates graphically the projected seasons of exploitation of selected fish species. As is apparent from this illustration, fishing is particularly a spring procurement activity, with various species being exploited throughout the summer. It is this spring fishing that makes this class (Pisces) a particularly critical resource. Mammals, at their lowest body weight after the long winter, could not provide a sufficient resource base. Cleland (1982) stresses

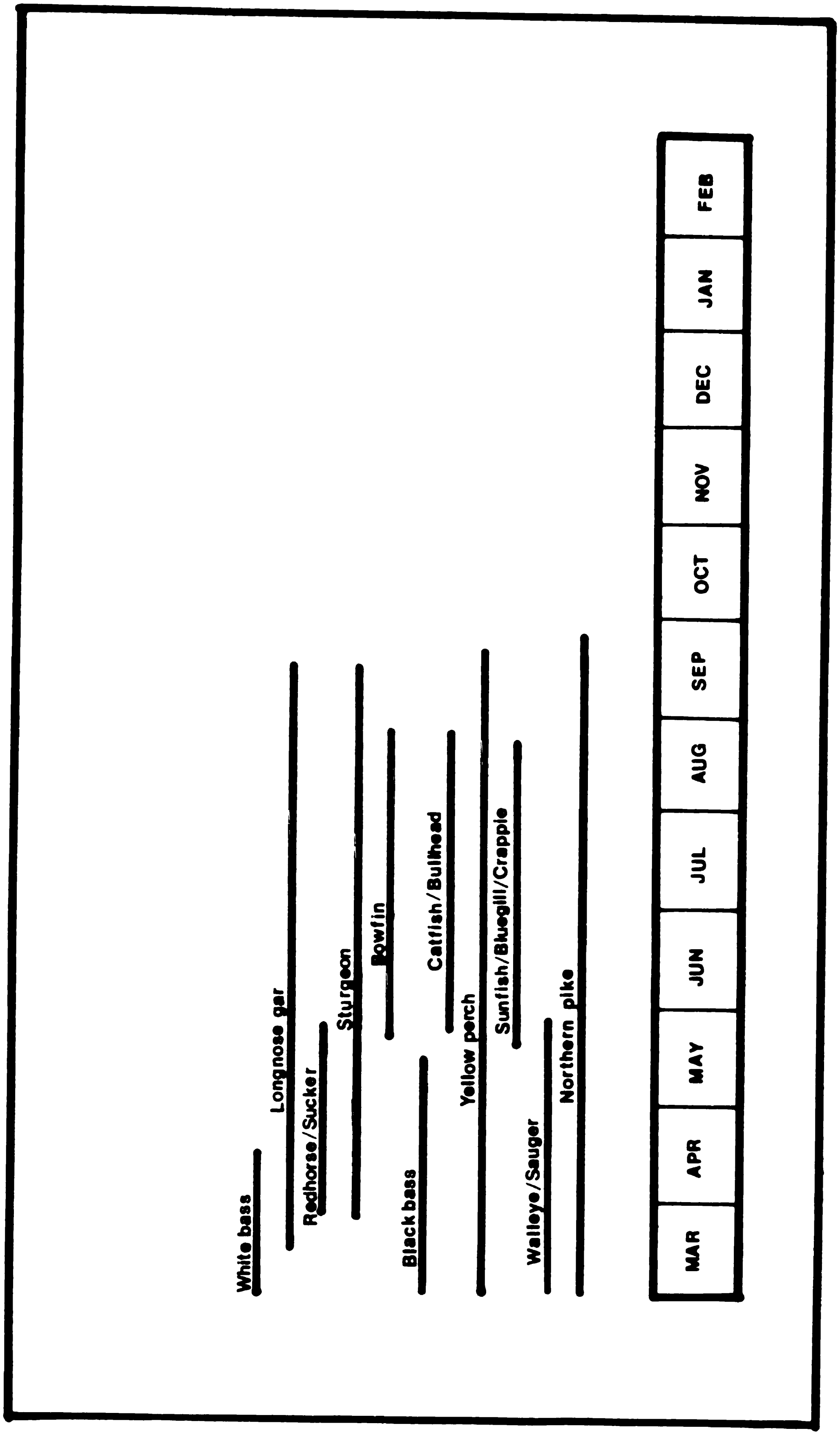


Figure 13 Projected Seasons of Exploitation of Selected Fish Species

that this is a vulnerable time for late prehistoric populations in the Upper Great Lakes. He also notes that generalized fishing (nets and weirs) would allow inhabitants of sites, such as the Sauer Resort site, to make it through this critical time. Based upon the suggested evidence, it is quite likely that these exploitive techniques were used at the Sauer Resort site. The exploitation of large amounts of fish at the site further indicates the importance of the aquatic environment to the subsistence practices of these people.

The emphasis upon different aquatic areas also changes with the seasons. Spring fishing activities were most probably centered upon the Wolf River. Moving approximately three miles (4.6 km) from the habitation area to the mouth of the Wolf River, inhabitants of the Sauer Resort site would make use of the river spawning species. It appears that, based upon the multitude of specimens identified for each species, the fish were brought back to the habitation site for processing. Summer fishing activities may also have included the Wolf River as a fishing area, but warm water spawning species such as the centrachids and ictalurids would also have been found in Lake Poygan. Using a variety of exploitive techniques, both collective and individualistic in nature, these resources could be exploited in closer proximity to the habitation area.

CLASS AVES

Birds

A varied and abundant avian fauna is represented at the Sauer Resort site. The avian assemblage provides further evidence of the exploitation of aquatic areas of the Fox-Wolf drainage, as well as upland prairies and forests. A total of 2331 avian specimens are identified in the assemblage, with 922 specimens (39.6%) identified to order or lower zoological taxa. Table 8 illustrates these identifications.

Table 8 Identified Avian Species of the Sauer Resort Site

FAMILY	SUBFAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL AVIAN SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
Cygninae		Duck spp.	773	84.02
		Subtotal Cygninae	773	84.02
Cygninae	Aythyinae	*Aythya* sp.	53	5.76
		Aythya affinis Lesser scaup	12	1.30
		Aythya valisineria Canvasback	8	0.87
		Aythya marila Greater scaup	4	0.43
		Bucephala clangula Common goldeneye	4	0.43
		Aythya collaris Ring-necked duck	3	0.33
		Aythya americana Redhead	3	0.33
		Subtotal Aythinae	87	9.45
	Oxyurinae	*Oxyura jamaicensis* Ruddy duck	3	0.33
		Subtotal Oxyurinae	3	0.33

Table 8 Continued

FAMILY	SUBFAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL AVIAN SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
	Merginae	*Mergus merganser* Common merganser	1	0.11
		Subtotal Merginae	1	0.11
		Subtotal All Diving Ducks	91	9.98
	Anatinae	*Anas platyrhynchos* Mallard	5	0.54
		Anas discors or *crecca* Blue or Green-winged teal	4	0.43
		Mareca americana American widgeon	2	0.22
		Aix sponsa Wood duck	1	0.11
		Anas acuta Pintail	1	0.11
		Subtotal Anatinae	13	1.40
		Subtotal All Puddle Ducks	13	1.40
		Ducks (All Zoological Taxa)	877	95.31

Table 8 Continued

FAMILY	SUBFAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL AVIAN SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
Anatidae	Anserinae	*Branta canadensis* Canada goose	7	0.76
		Chen caerulescens Snow goose	1	0.11
		Subtotal Anserinae	8	0.87
		Subtotal All Waterfowl	885	96.20
Podicipedidae		*Podilymbus podiceps* Pied-billed grebe	9	0.98
		Subtotal Podicipedidae	9	0.98
Rallidae		*Fulica americana* American coot	7	0.76
		Porzana carolina Sora	1	0.11
		Subtotal Rallidae	8	0.87
Ardeidae		*Nycticorax nycticorax* or *Botaurus lentiginosus* Black-crowned night heron or American bittern	2	0.22

Table 8 Continued

FAMILY	SUBFAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL AVIAN SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
		Subtotal Ardeidae	2	0.22
		Subtotal All Shorebirds	19	2.07
Accipitridae		*Buteo* sp.	4	0.43
		Buteo jamiacensis Red-tailed hawk	2	0.22
		Accipiter sp.	1	0.11
		Subtotal Accipitridae	7	0.76
		Passeriformes (ORDER)	5	0.54
		Subtotal Passeriformes	5	0.54
Columbidae		*Ectopistes migratorius* Passenger pigeon	2	0.22
		Subtotal Columbidae	2	0.22
Picidae		*Colaptes auratus* Common flicker	2	0.22

Table 8 Continued

FAMILY	SUBFAMILY	SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL AVIAN SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
		Subtotal Picidae	2	0.22
		Subtotal All Upland Birds	16	1.74
		Total All Birds	920	100.01

In the discussion of the behavioral characteristics and archaeological significance of the avian species represented, an assumption has been made. Because the species identification is considered less meaningful in the archaeological reconstruction, emphasis is placed upon the behavioral characteristics which seem to group at the family level in most cases, with the exception of ducks which are described at the subfamily level. As a further grouping, based upon archaeological significance, families are grouped together under the categories of waterfowl (ducks and geese), shorebirds (coots, soras, bitterns, and grebes) and upland birds (hawks, passenger pigeons, and flickers). These groupings will allow comparisons to be made between the environmental orientation of the avian species represented in the assemblage.

Behavioral and Habitat Characteristics of the Represented Bird Species

In the following description of the duck species represented at the Sauer Resort site, subfamilies have been combined into two groups, diving ducks including the subfamilies Aythyinae, Oxyurinae, and Merginae, and puddle ducks represented by the subfamily Anatinae. In so doing, various morphological and behavioral characteristics of these groups may be seen.

The bay or diving ducks, include the lesser and greater scaup, canvasback, ring-necked duck, redhead, common goldeneye, ruddy, and common merganser in the assemblage. Diving ducks live in deep water areas (ie. Wolf River), and feed on a variety of food resources. Predominantly aquatic in nature, submergent and emergent vegetation, fish, insects, and freshwater mussels are all foods for the diving ducks. The prehistoric environment of the Fox-Wolf drainage would provide excellent habitat for these species.

From a behavioral perspective, diving ducks do not commonly nest in the Fox-Wolf drainage, but do congregate or raft in large numbers during the non-breeding periods. Migrating through this area various species are available during different seasons of the year. The greater and lesser scaup migrate through this area in early spring and late fall, with the canvasback only found in the fall (Gromme 1974). The ring-necked duck, ruddy duck, and common merganser are considered transients during the spring, summer, and fall (Gromme 1974). The common golden-eye migrates through central Wisconsin during the fall, winter, and spring (Gromme 1974).

The puddle or dabbling ducks include the mallard, pintail, blue and green-winged teal, wood duck, and American widgeon in the assemblage. Puddle ducks, unlike diving ducks, utilize both aquatic and upland areas as a source of food. Feeding on a variety of foods, the main diet of the species is vegetal matter such as emergent and submergent vegetation, as well as acorns and other upland vegetation types. The combination of both aquatic and upland environments are important to these species.

Unlike the diving ducks, three of the five puddle duck species presently nest in the Fox-Wolf drainage. Nesting takes place in summer and early fall with the puddle ducks experiencing a post-breeding molt which leaves them flightless for a short period of time (Trippensee 1953). These nesting species are present in the spring, summer, and fall (Gromme 1974). Although the mallard is considered a winter resident presently, it is quite possible that it did not winter in the Fox-Wolf drainage during prehistoric times. Extensive agricultural activities presently would provide food for this species that would not have been available prehistorically.

Two species of geese, the Canada goose and the snow goose (Family Anatidae) are found in the assemblage. The Canada goose enjoys both terrestrial and aquatic environments preferring large open lakes. The

Canada goose is a migrating species which is most commonly found in the area in spring and fall (Gromme 1974). The snow goose shares similar environments and would find excellent habitat in the Fox-Wolf drainage. The snow goose is an uncommon transient in the spring and a fairly common transient in the fall (Gromme 1974).

Upland bird species are represented by three families including the family Accipitridae (red-tailed hawk and genera _Buteo_ and _Accipiter_), the family _Columidae_ (passenger pigeon), and the family Pierdae (common flicker). All of the species in these families are permanent nesting residents in the Fox-Wolf drainage. Habitats are generalized, and the area exploited for nesting and food includes the upland deciduous forests and prairies surrounding the Sauer Resort site. In particular, the passenger pigeon, now extinct, would have found excellent habitat in this area. Known for the large numbers of birds nesting in a single woodlot (Godfrey 1966), this species could have been found in large numbers adjacent to the site.

Archaeological Significance of the Class Aves

The significance of the avian assemblage may be demonstrated by a variety of factors. The projected meat yield, the number of individuals represented, and the ecological orientation of the avian species, are all critical in evaluating the avian assemblage. In Table 9, the represented avian species are hierarchically ranked according to their meat contributions, by family and subfamily.

Table 10 follows a similar orientation by hierarchically ranking the identified avian specimens by the total minimum number of individuals represented. There are 920 specimens identified in the avian assemblage; these specimens represent, however, only 74 individuals. This ratio might suggest that most avian elements from these individuals are present

Table 9 Avian Fauna of the Sauer Resort Site 47/WN/207 (Grouped by Family/Subfamily)

FAMILY SUBFAMILY SPECIES	SPECIMENS	MNI	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Cygninae					
Aythyinae					
Aythya sp.	53	10	sternum	10.0	11.5
Aythya marila Greater scaup	4	3	left coracoid	4.2	4.8
Aythya affinis Lesser scaup	10	5	left coracoid	3.5	4.0
cf. *Aythya affinis*	2	-			
Aythya valisineria Canvasback	8	3	sternum	3.3	3.7
Bucephala clangula Common goldeneye	2	2	left coracoid	2.0	2.3
cf. *Bucephala clangula*	2	-			
Aythya collaris Ring-necked duck	3	2	right coracoid	1.8	2.0
Aythya americana Redhead	3	1	left coracoid	1.05	1.2
SUBTOTAL AYTHYINAE	87	26		25.85	29.5

Table 9 Continued

FAMILY SUBFAMILY SPECIES	SPECIMENS	MNI	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Merginae Mergus merganser	1	1	sternum	2.1	2.4
SUBTOTAL MERGINAE	1	1		2.1	2.4
Oxyurinae Oxyura jamaicensis Ruddy duck	3	2	left coracoid	1.4	1.6
SUBTOTAL OXYURINAE	3	2		1.4	1.6
SUBTOTAL ALL DIVING DUCKS	91	29		33.5	37.9
Anatinae Anas platyrhynchos Mallard	5	1	right coracoid	1.75	2.0
Aix sponsa Wood duck	1	1	right coracoid	1.05	1.2
Anas acuta Pintail	1	1	sternum	.7	.8
Anas discors or crecca Blue or Green-winged teal	4	1	right coracoid	.7	.8
Mareca americana American widgeon	2	1	left humerus	.7	.8

Table 9 Continued

FAMILY SUBFAMILY SPECIES	SPECIMENS	MNI	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
SUBTOTAL ANATINAE	13	5		4.9	5.6
SUBTOTAL (ALL PUDDLE DUCKS)	13	5		4.9	5.6
Duck sp.	773	24		24.0	27.2
Cygninae					
SUBTOTAL CYGNINAE (ALL SPECIES)	877	58		58.25	66.3
Anatidae					
Anserinae					
Branta canadensis Canada goose	7	2	left humerus	11.2	12.7
Chen caerulescens Snow goose	1	1	furculum	4.0	.5
SUBTOTAL ANSERINAE	8	3		15.2	17.2
SUBTOTAL (WATERFOWL)	885	61		73.45	83.5
Accipitridae					
Buteo jamaicensis Red-tailed hawk	2	1	left coracoid	2.0	2.3
Buteo sp.	4	1	left scapula	2.0	2.3

Table 9 Continued

FAMILY SUBFAMILY SPECIES	SPECIMENS	MNI	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Accipiter sp. Hawk	1	1	right tarsometatarsus	2.0	2.3
SUBTOTAL ACCIPITRIDAE	7	3		6.0	6.9
Columbidae					
Ectopistes migratorius Passenger pigeon	2	2	left tibiotarsus	1.4	1.6
SUBTOTAL COLUMBIDAE	2	2		1.4	1.6
Picidae					
Colaptes auratus Common flicker	2	1	left humerus	.35	.4
SUBTOTAL PICIDAE	2	1		.35	.4
Passeriformes (Order)	5	2	left ulna	-	
SUBTOTAL (UPLAND BIRDS)	16	8		7.75	8.9

Table 9 Continued

FAMILY SUBFAMILY SPECIES	SPECIMENS	MNI	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
Ardeidae					
Nycticorax nycticorax or *Botaurus lentiginosus* Black-crowned night heron or American bittern	2	1	right tibiotarsus	3.0	3.4
SUBTOTAL ARDEIDAE	2	1		3.0	3.4
Rallidae					
Fulica americana American coot	7	3	right scapula	2.1	2.4
Porzana carolina Sora	1	1	left carpometacarpus	.5	.6
SUBTOTAL RALLIDAE	8	4		2.6	3.0
Podicipedidae					
Podilymbus podiceps Pied-billed grebe	7	2	left coracoid	1.4	1.6
cf. *Podilymbus podiceps*	2	-			
SUBTOTAL PODICIPEDIDAE	9	2		1.4	1.6
SUBTOTAL (SHOREBIRDS)	14	7		7.0	7.9

Table 9 Continued

FAMILY SUBFAMILY SPECIES	SPECIMENS	MNI	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD BY CLASS
TOTAL BIRDS	920	76		88.2	100.3

Table 10 Hierarchial Ranking of Exploited Avian Species (Grouped by Family/Subfamily) Based Upon Total MNI-Subsistence Related

FAMILY	SUBFAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF AVIAN MNI
Cygninae	Aythyinae	Aythya sp.	10	13.51
		Aythya affinis Lesser scaup	5	6.76
		Aythya marila Greater scaup	3	4.05
		Aythya valisineria Canvasback	3	4.05
		Aythya collaris Ring-necked duck	2	2.70
		Bucephala clangula Common goldeneye	2	2.70
		Aythya americana Red head	1	1.35
		Subtotal Aythyinae	26	35.12
	Oxyurine	Oxyura jamaicensis Ruddy duck	2	2.70
		Subtotal Oxyurine	2	2.70
	Merginae	Mergus merganser Common merganser	1	1.35
		Subtotal All Diving Ducks	29	39.17

Table 10 Continued

FAMILY	SUBFAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF AVIAN MNI
		Duck spp.	24	32.43
		Subtotal Duck spp.	24	32.43
	Anatinae	*Anas platyrhynchos* Mallard	1	1.35
		Anas acuta Pintail	1	1.35
		Anas discors/crecca Blue/Green-winged teal	1	1.35
		Aix sponsa Wood duck	1	1.35
		Mareca americana American widgeon	1	1.35
		Subtotal Anatinae	5	6.75
		Subtotal All Puddle Ducks	5	6.75
		Subtotal Ducks (All Zoological Taxa)	58	78.35
Anatidae	Anserinae	*Branta canadensis* Canada goose	2	2.70
		Chen caerulescens Snow goose	1	1.35

Table 10 Continued

FAMILY	SUBFAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF AVIAN MNI
		Subtotal Anserinae	3	4.05
		Subtotal All Waterfowl	61	82.43
Rallidae		Fulica americana American coot	3	4.05
		Porzana carolina Sora	1	1.35
		Subtotal Rallidae	4	5.40
Podicipedidae		Podilymbus podiceps Pied-billed grebe	2	2.70
		Subtotal Podicipedidae	2	2.70
Ardeidae		Nyticorax nycticorax or Botaurus lentiginosus Black-crowned night heron or American bittern	1	1.35
		Subtotal Ardeidae	1	1.35
		Subtotal All Shorebirds	7	9.45

Table 10 Continued

FAMILY	SUBFAMILY	SPECIES	MNI	% OF TOTAL NUMBER OF AVIAN MNI
Accipitridae		*Buteo* sp.	1	1.35
		Buteo jamaicensis Red-tailed hawk	1	1.35
		Accipiter sp.	1	1.35
		Subtotal Accipitridae	3	4.05
Columbidae		*Ectopistes migratorius* Passenger pigeon	2	2.70
		Subtotal Columbidae	2	2.70
Picidae		*Colaptes auratus* Common flicker	1	1.35
		Subtotal Picidae	1	1.35
		Subtotal All Upland Birds	6	8.10
		Total All Avian MNI	74	100.0

in the faunal assemblage, and therefore could indicate that avian species were not considered a stable resource. The large number of specimens and low number of individuals can further indicate that the projected meat yield contributed by avian species is a reliable prediction of the importance of these species in the total subsistence strategy. This has direct ramifications on discussions of procurement technology and site seasonality.

There is no evidence to suggest that any particular technology was practiced to exploit any particular species. The archaeological significance of the avian fauna is therefore discussed at a super-species level. The behavioral and habitat characteristics that most closely group the species identified to allow meaningful archaeological interpretation is the family and subfamily. The individual species are not considered significant because there is no apparent selection for any one species over another. Rather, it is argued that selection occurs for groups within which several species share similar behaviors and habitats.

The duck species present in the assemblage may be divided into two groups based upon habitat and behavioral characteristics. The diving ducks include the subfamilies Aythyinae, Marginae, and Oxyurinae. A total of 91 specimens were identified within these subfamilies, with at least 29 individuals represented. These individuals account for 33.5 pounds of meat, or 37.9% of the total avian meat yield. The puddle ducks, represented by a single subfamily Anatinae, are identified based upon 13 specimens, with five individuals represented. The five puddle duck individuals account for 4.9 pounds of meat, or 5.6% of the total avian meat yield.

Given the disparity between the number of diving ducks represented relative to the number of puddle ducks, it is possible to hypothesize that the means of capture may be responsible for the greater number of diving ducks represented in the assemblage.

Ethnohistorical accounts describing the capture of ducks may be useful. Andre, writing in 1672, describes the taking of fish and ducks together at the mouth of the Fox River, near Green Bay (Thwaites 1959:56:121). As described previously, the fish assemblage indicates that netting technology was most probably used to procure the large numbers of fish noted in the assemblage. It is quite possible that the ducks represented in the assemblage were incidental captures that occurred while people were pursuing the various fish species represented. Andre describes this process as follows:

> The bay commonly called des Puans receives a river, in which wild fowl and fish are caught both together. Of this practice the savages are the inventors; for, perceiving that Ducks, Teal, and other birds of that kind dive into the water in quest of the grains of wild rice to be found there toward the Autumn season, without counting the fish, they sometimes catch in one night as many as a hundred wildfowl. This fishing is equally pleasant and profitable; for it is a pleasure to see in a net, when it is drawn out of the water, a Duck caught side by side with a pike, a Carp entangled in the same meshes with Teal (Thwaites 1959:121).

Although Andre may have observed this netting technology in the fall, it is quite likely that this technique was used in spring as well. Because of the small size of diving ducks and their habit of diving deep into the water in search of fish, it is quite possible that diving ducks and small puddle ducks such as teal would be more often taken in this manner than the large-bodied puddle ducks (ie. mallard). Both diving ducks and puddle ducks are found in the Fox-Wolf drainage in the spring and fall, and may have fallen prey to the fishing nets. Given the vast majority of spring spawning fish species at the Sauer Resort site, it is likely that net fishing was used during this season, with spring migrating bird species taken at the same time. It is also possible that nets were set in the fall to capture fish such as the northern pike, with ducks also taken during this season as well in the same manner. It is interesting to note that puddle ducks, such as the mallard, blue and green-winged teals, and wood duck, unlike the diving duck species, nest in the Fox-Wolf drainage in late summer. Nesting in this area, these species would experience a post-breeding molt which would render them flightless for a short period of time (Trippensee 1953). It is possible that the puddle ducks may have been taken during this period of flightlessness, when they are unable to escape capture.

The family Anatidae, including the Canada goose and snow goose, are noted in the assemblage. This family is identified by 8 specimens, representing three individuals. These three individuals account for a projected meat yield of 15.2 pounds, or 17.2% of the total avian meat yield. Although it is not possible to speculate on the means of capture of the geese, these species migrate through central Wisconsin in the spring and fall, and were most probably taken during these seasons.

Waterfowl, all duck and geese species together, represent 61 individuals, which is 80.3% of the total number of avian individuals present in the assemblage. These individuals account for 73.45 pounds of meat, which is 83.5% of the total avian meat yield. It is apparent from these calculations that avian species favoring aquatic habitats were exploited to a much greater extent than upland species. It is quite possible that the ease of capture of the waterfowl species allowed these species to be more readily taken than the upland species.

The family Accipitridae includes the genera <u>Buteo</u> and <u>Accipiter</u>, and the species red-tailed hawk. This family is identified by seven specimens, representing three individuals. The projected meat yield is 6.0 pounds. These individuals may have been used as a food resource, but may also have been taken for their feathers.

The family Columbidae, including the species passenger pigeon is identified by 2 specimens, representing 2 individuals. These two individuals would account for only 1.4 pounds of meat. It is surprising that there are only two individuals representing the passenger pigeon. Historical records (Radin 1923:113) indicate that nesting passenger pigeons were taken by the Winnebago in large numbers during the "chief's feast". For some unknown reason, the passenger pigeon was not widely exploited at the Sauer Resort site. It is possible that different social organization was present at the Sauer Resort site.

The common flicker, representing the family Picidae, is identified by two specimens, with only a single individual present. The presence of this individual in the assemblage is incidental, and would contribute little as a food resource.

Upland bird species at the Sauer Resort site are identified by a total of 16 specimens with 8 individuals present. The meat yield is only 7.75 pounds, or 8.9% of the total meat yield. As a whole, upland species would provide a small percentage of the total projected avian meat yield.

The family Ardeidae, which includes the black-crowned night heron and the American bittern, is identified in the assemblage. Two anatomical elements were identified to this family, however, it was not possible to determine whether the elements represented the black-crowned night heron or the American bittern. Based upon osteological evidence, these two species are difficult to separate. Both of these birds are of similar size, and both share similar behaviors and environments. Both of these species are known to nest in the Fox-Wolf drainage presently (Gromme 1974), and it is quite likely that the individual represented in the assemblage may have been taken during the nesting period.

The American coot and sora, representing the family Rallidae, are identified by 8 specimens with at least 4 individuals present. These four individuals account for only 2.6 pounds of meat. These two species are known to nest in the Fox-Wolf drainage, and may have been taken on a opportunistic basis during the summer or fall.

The family Podicipedidae, including the species pied-billed grebe, is identified by seven specimens, representing two individuals. Like the other shorebirds, the pied-billed grebe would provide a small amount of meat, and were probably taken when opportunity presented itself during the summer nesting period.

Shorebirds, identified by 19 specimens, representing 7 individuals, would have provided only a small amount of meat (7.0 pounds) and are considered a minor resource.

Bird Fauna - Evidence of Ecological Orientation and Seasonality

The identification of predominantly aquatic bird species in the assemblage is a further indication of the importance of the aquatic environment to the inhabitants of the Sauer Resort site. If waterfowl and shorebird species are included together, 68 individuals are represented. At least two factors may be responsible for the large number of aquatic species found in the assemblage. It may be hypothesized that the high biomass of bird species residing in the aquatic environment, coupled with the ease with which they may be captured, may point toward possible reasons for the high percentage of aquatic species in the assemblage. The exception to this would be the potential for the expolitation of a great number of passenger pigeon, but they were not widely exploited. There is a danger in any faunal analysis of assuming that resources that are the most frequently found and most easily exploited should be represented in the highest numbers in the archaeological assemblage.

Cognitive cultural factors, not preserved in the archaeological record, are most certainly influential in specific resource selection. It is possible that such cultural considerations are responsible for the lack of such a potentially useful resource as the passenger pigeon.

As a whole, avian species are effective indicators of site seasonality. Because many migrating species are only available in the Fox-Wolf drainage at certain times of the year, the evidence of their exploitation points to the occupation of the site during particular seasons to procure these resources. Figure 14 illustrates the projected primary seasons of exploitation of the various avian groups discussed. As is evident from the illustration, the majority of avian species were taken in the spring through the fall. Importantly, no exclusively winter bird species were identified in the assemblage, and, therefore, there is no evidence based on the avian assemblage, that the site was occupied in winter.

CLASSES REPTILIA AND AMPHIBIA

Turtles, Snakes, Frogs, and Toads

The marsh-like conditions of the Fox-Wolf drainage would provide excellent habitat for reptilian and amphibian fauna. The reptiles and amphibians found in the Sauer Resort site assemblage is a further indication of the use of the aquatic habitat as a resource base. A total of 526 reptile and amphibian specimens are identified in the assemblage, with 466 specimens (88.6%) identified to order or lower zoological taxa. Table 11 summarizes this data.

For the purpose of describing the behavioral and habitat characteristics of reptiles and amphibians, each class is described separately. Within the class Reptilia, all turtle species are described as a single group; the snake species comprise a second group for description. For the amphibian class, only a general discussion is possible because

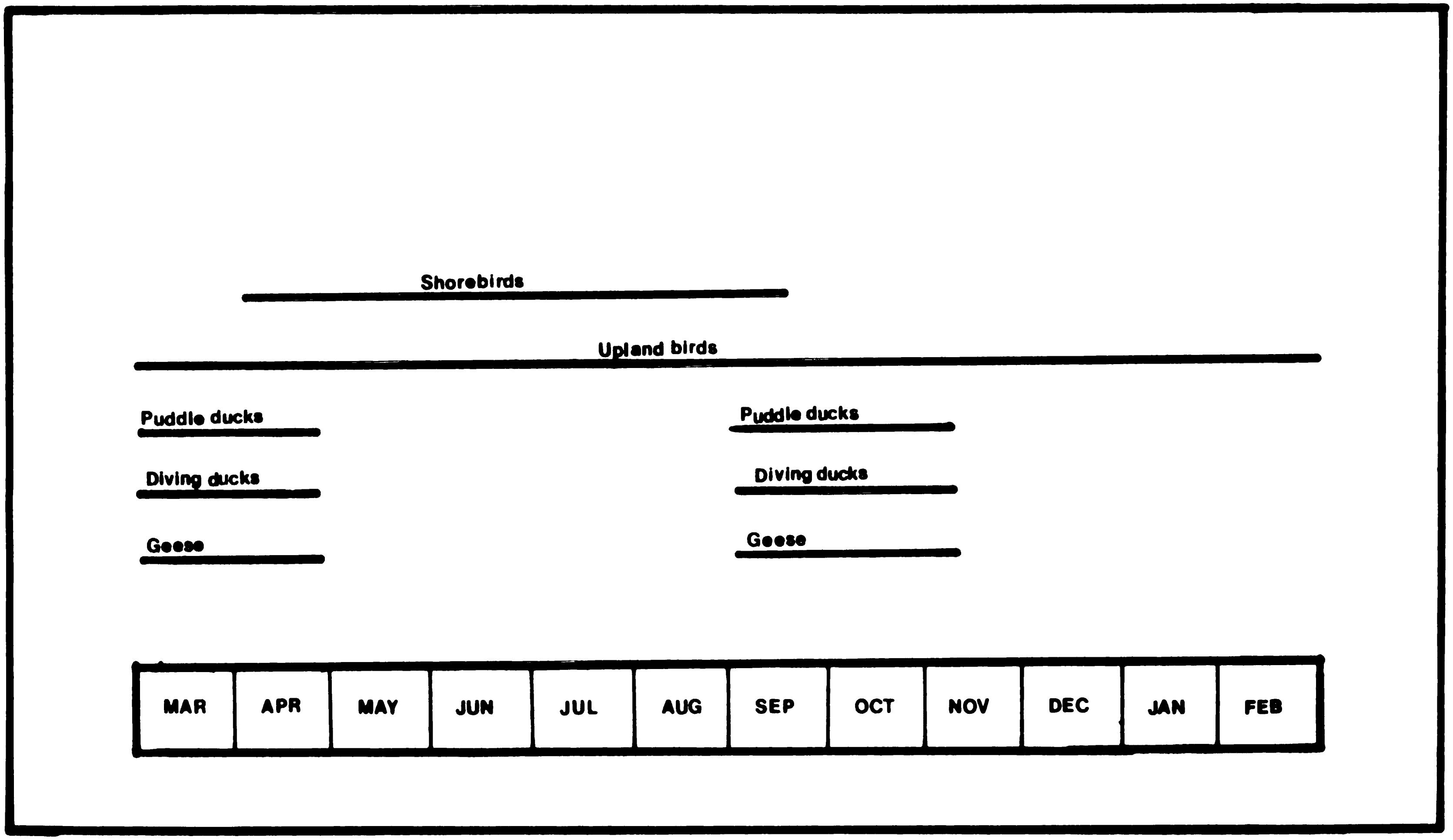


Figure 14 Projected Seasons of Exploitation of Selected Avian Species

Table 11 Identified Reptilian and Amphibian Species of the Sauer Resort Site

SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL AMPHIBIAN AND REPTILE SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
Turtle spp.	116	24.90
Chysemys picta Painted turtle	106	22.75
Chelydra serpentina Snapping turtle	63	13.50
Rana sp. Frogs	54	11.60
Emdoidea blandingi Blanding's turtle	44	9.44
Bufo sp. Toads	36	7.70
Rana/*Bufo* spp.	34	7.30
Graptemys geographica Map turtle	7	1.50
Sistrurus catenatus Eastern Massasauga rattlesnake	2	0.43
Trionyx spinifer Eastern spiny softshell turtle	1	0.22

Table 11 Continued

SPECIES	# OF SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA	% OF TOTAL AMPHIBIAN AND REPTILE SPECIMENS IDENTIFIED TO ORDER OR LOWER ZOOLOGICAL TAXA
Terrapene carolina Box turtle	1	0.22
Elaphe vulpina Fox snake	1	0.22
cf. *Clemmys insculpta* Wood turtle	1	0.22
Total Amphibians and Reptiles	466	100.00

identifications of the amphibians represented could only be determined to the genus level.

Behavioral and Habitat Characteristics of the Represented Reptile and Amphibian Species

A total of six turtle species were identified in the Sauer Resort site assemblage. These species include the painted, snapping, spiny soft-shelled, Blanding's, box, and map turtles. There is also the tentative identification of a wood turtle. The painted, snapping, Blanding's, and map turtles all enjoy marsh and lake habitats (Vogt 1981). Spending the vast majority of their time in water, these species eat a variety of foods, including snails, crayfish, insects, fish, algae, and cattails (Vogt 1981). The painted and map turtles congregate in large numbers to bask in the sun. The eastern spiny softshell turtle, unlike the other aquatic species, does not prefer marsh areas, and is most often found in clear running streams (Vogt 1977). Two species, the box and wood turtles, are predominantly terrestrial species. These terrestrial species feed upon a variety of plant vegetation including berries and grasses, and various insects (Vogt 1981). All represented turtle species would find excellent habitat surrounding the Sauer Resort site.

The active seasons of the turtle species would vary only slightly. Species such as the painted, snapping, Blanding's, eastern spiny softshell, and wood turtles would be found in this area between April and October (Vogt 1981). These species would experience a period of brumation between November and late March. The box and map turtles brumate longer (November to late May) than the other represented species, and would only be found from early summer to fall (late May to late October).

Two snake species, including the eastern Massassauga rattlesnake and the fox snake are represented in the assemblage. The Massassauga rattlesnake is found in mesic prairie and lowland areas, along rivers and lakes in Wisconsin (Vogt 1981). The fox snake is found in a variety of habitats including the oak savannas, southern lowland forests, and dry upland areas (Vogt 1981). Both of these snakes are active from late April through October (Vogt 1981), and would find favorable habitat surrounding the Sauer Resort site.

It is difficult to reconstruct the specific habitats of the represented amphibian species in the assemblage because identification could only be made to the genus level, and amphibians are niche sensitive species. Generally speaking, the frogs (genus Rana) are predominantly aquatic species, while the toads (genus Bufo) are more terrestrial species.

Archaeological Significance of the Classes Reptilia and Amphibia

The significance of the reptiles and amphibians represented in the faunal assemblage may be illustrated in two ways. Table 12 hierarchically ranks the identified reptile and amphibian species based upon meat yield. It is apparent from this table that turtles represent a very small amount of meat, and must be considered an incidental resource in comparison to the other animal classes. Amphibians and snakes are not considered in meat calculations. Table 13 hierarchically ranks the identified species (subsistence related) by the minimum number of individuals present.

The importance of turtles in the reptilian assemblage is described by dividing the species into two groups, based upon general habitat and behavioral characteristics. Aquatic species such as the painted, Blanding's, eastern spiny softshell, map, and snapping turtles are identified based on 221 specimens with at least 13 individuals represented. All of the aquatic turtles, with the exception of the snapping turtle, are small to medium-sized animals. These turtle species were most

Table 12 Reptilian and Amphibian Fauna of the Sauer Resort Site 47/WN/207

SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD OF THE COMBINED REPTILIAN AND AMPHIBIAN CLASSES
Chelydra serpentina Snapping turtle	61	2	left scapula	15.0	61.7
cf. Chelydra serpentina	2	-			
Emydoidea blandingi Blanding's turtle	41	3	CL4	4.5	18.5
cf. Emydoidea blandingi	3	-			
Chrysemys picta Painted turtle	106	6	CR4	1.5	6.2
Graptemys geographica Map turtle	5	1	ML 11	1.5	6.2
cf. Graptemys geographica	2	-			
Trionyx spinifer Eastern spiny softshell turtle	1	1	costal (no position)	1.5	6.2
Terrapene carolina Box turtle	1	1	CL3	.3	1.2
cf. Clemmys insculpta Wood turtle	1	-			

Table 12 Continued

SPECIES	SPECIMENS	MINIMUM NO. INDIVIDUALS	ELEMENT USED TO DETERMINE MNI	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD OF THE COMBINED REPTILIAN AND AMPHIBIAN CLASSES
Turtle spp.	116	-			
Sistrurus catenatus Eastern Massasauga rattlesnake	2	1	vertebra (no position)	-	
Elaphe vulpina Fox snake	1	1	vertebra (no position)	-	
Rana sp. Frogs	54	11	right humerus	-	
Bufo sp. Toads	36	6	right illium	-	
Rana/*Bufo* spp.	34	-			
Total Reptiles and Amphibians	446	33		24.3	100.0

Table 13 Hierarchical Ranking of Exploited Reptile Species (Subsistence Related) based upon total MNI

SPECIES	MNI	% OF TOTAL REPTILE MNI
Painted turtle	6	42.86
Blanding's turtle	3	21.43
Snapping turtle	2	14.29
Map turtle	1	7.14
Box turtle	1	7.14
Eastern spiny softshell turtle	1	7.17
TOTAL	14	100.00

probably exploited as opportunistic captures, or may have become entangled in fish nets. The small number of individuals does not indicate that these species were purposefully exploited as a staple resource.

The snapping turtle, unlike the small and medium-sized aquatic turtles, warrents additional consideration. The snapping turtle elements identified in the assemblage indicate that very large individuals were taken. These individuals may have weighed up to 20 pounds each. Snapping turtles were most probably taken using an individualistic technique in the spring or summer. They were probably not caught in fish nets because they could easily bite their way out of such a predicament.

The identification of a single specimen of the box turtle, and the tentative identification of the wood turtle indicates that terrestrial turtles were rarely captured. These turtles were most probably taken when opportunity presented itself.

The largest amount of meat (15 pounds) is produced by the snapping turtle with the other aquatic and terrestrial turtles providing an additional 9.3 pounds of meat. The importance of turtles as a food resource can only be considered minimal.

The identification of two snake species, the Massassauga rattlesnake (one specimen) and the fox snake (one specimen) is noted in the assemblage. These snakes are not considered a food resource. These species provide further evidence that marsh-like conditions were found near the Sauer Resort site.

The class Amphibia is defined by two genera, Rana (frogs) and Bufo (toads). A total of 54 specimens, representing 11 individuals, are identified to the genus Rana, and 36 specimens, representing 6 individuals, are identified to the genus Bufo. It is possible that the inhabitants of the Sauer Resort site used frogs and toads as food. However, it is considered more likely that frogs and toads are intrusive in the midden refuse of the site.

Reptilian and Amphibian Fauna - Evidence of Ecological Orientation and Seasonality

The presence of various reptile and amphibian species in the Sauer Resort site assemblage is further indication that aquatic habitats were being exploited. Although these classes do not represent a significant amount of food, they do however, indicate that the aquatic environment surrounding the Sauer Resort site was exploited for a variety of animal resources. The presence of turtles considered as food items in the assemblage also indicate that the Sauer Resort site was occupied during the spring through fall, when turtles are available for exploitation. Figure 15 illustrates the projected season of exploitation of selected reptile species.

CLASS PELECYPODA

Freshwater Mussels

A large and varied pelecypod fauna is found in the Fox-Wolf drainage and is represented by 11 species in a sample taken from the Sauer Resort site assemblage. Only a sample of the freshwater mussels was collected at this site. Therefore, no quantification of usable meat (projected meat yield) may be determined. Although it is impossible to determine a percentage for the importance of this resource based upon the number of shells uncovered during the excavation, freshwater mussels may have been a valuable supplementary resource.

Identification of 11 species from the sample (two 10 cm levels) taken during excavation is illustrated in Table 14. These identifications and percentages, not useful for quantification purposes with regard to the subsistence pattern, provide data for the reconstruction of the prehistoric aquatic environment. Since pelecypod species are

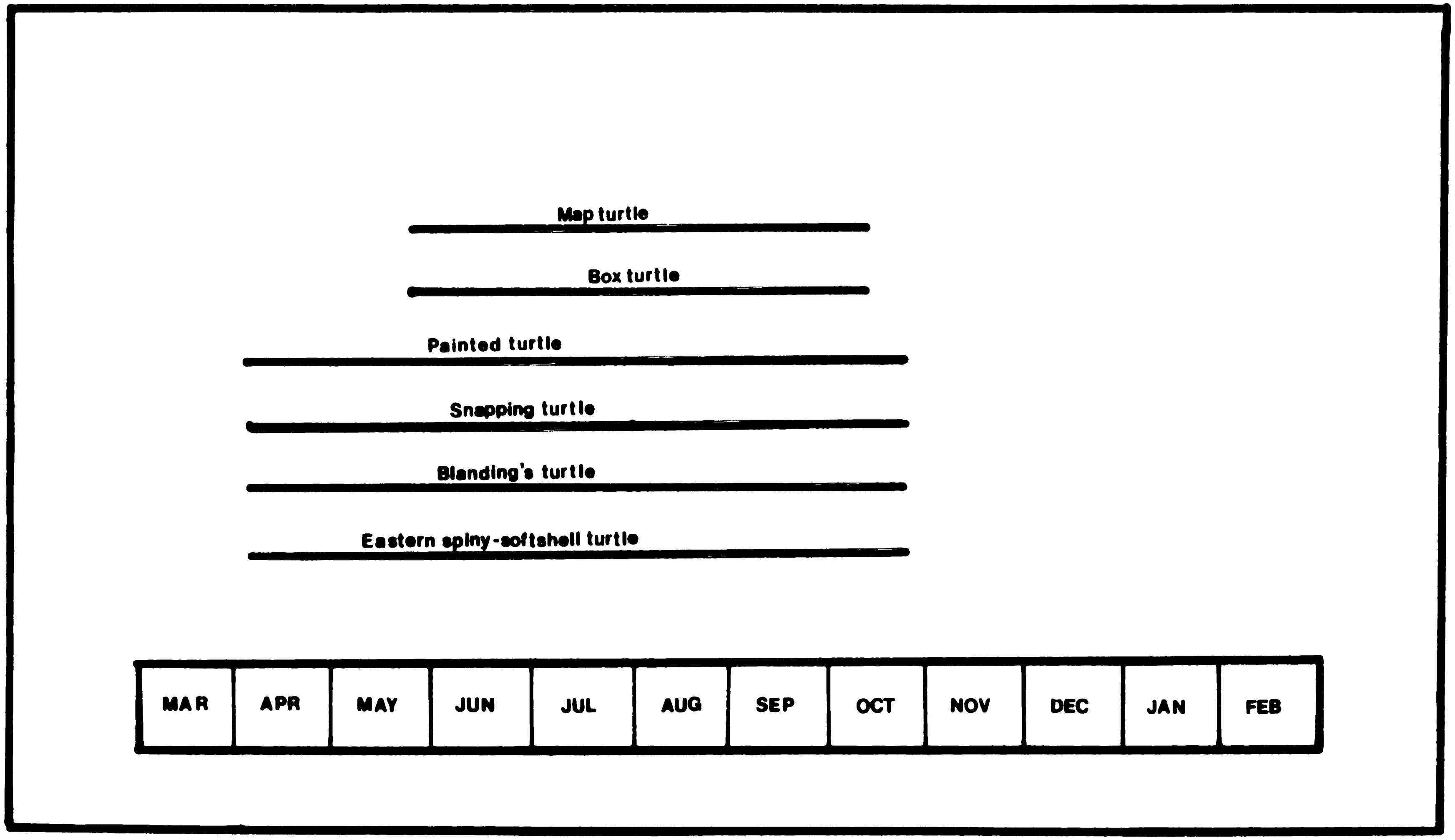


Figure 15 Projected Seasons of Exploitation of Selected Reptile Species

Table 14 Sample of Freshwater Mussels (Pelecypoda) from the Sauer Resort site 47/WN/207

SPECIES	IDENTIFIED SHELLS	MNI	% OF SAMPLE
Elliptio dilatatus Spike	144	73	37.2
Amblema plicata Three ridge	138	70	35.7
Lampsilis radiata silquoidea Fat mucket	63	39	19.9
Actinonaias carinata Mucket	7	1	.5
Lampsilis ovata ventriocosa	6	6	3.1
Pleurobema cordatum Ohio River pigtoe	2	2	1.0
Fusconaia flava Pigtoe	1	1	.5
Quadrula quadrula Mapleleaf	1	1	.5
Lasmigona costata Fluted shell	1	1	.5
Potamilus alata Pink heelsplitter	1	1	.5
Ligumia recta Black sandshell	1	1	.5
Total Mussels	365	196	100.0

extremely niche sensitive, their presence is indicative of particular aquatic conditions, and suggests specific kinds of aquatic habitats that were exploited prehistorically.

Of the 11 species represented in this sample, seven species favor fast water river habitats with sandy, gravel bottoms, while 3 species are found in slow-moving lakes with muddy bottoms. According to Baker (1928), *Pleurobema cordatum*, *Fusconaia flava*, *Quadrula quadrula*, *Lampsilis ovata ventricosa*, *Amblema plicata*, and *Actinonais carinata* are found in the Wolf and Fox Rivers, in shallow and deep water (5 cm - 3 m). *Potamilus alata*, *Ligumia recta*, *Lampsilis radiata silquoidea*, and *Elliptio dilatus* are found in the mud bottom of Lake Poygan, in shallow water (5 cm - 1 m). One species, *Lasmigona costata*, is found in both habitats (Baker 1928).

Of the 11 species represented from this sample, three species make up 92.8% of the total number of individuals. Two of these species, *Amblema picta* and *Lamptilis radiata silquordea* are deep water river species, while one species *Elliptio dilatatus* is a shallow lake species. Two factors may be responsible for these proportions. The river species represent very large individuals that produce a fair amount of meat per individual. Although difficult to exploit in comparison to the shallow lake species, these species would supply more meat than the smaller lake species. The only exception to this is the ubiquitous *Elliptio dilatatus*. This small, thin shelled mussel could be taken in large quantities in close proximity to the site.

It is evident that the residents of the Sauer Resort site traveled up to 3 mi to procure fresh water mussels. These mussels were brought back to the site and processed there. There were many unopened shells noticed during the excavation. It is apparent that these shells were heated in an attempt to open them. According to Victoria Dirst (personal communication), wear patterns on beaver incisors suggest that after mussel shells were heated beaver incisors may have been used to pry open the shells. Evidently, the shells that could not be opened were discarded. However, the large number of shells indicates that mussel were a valuable resource. Mussels could have been used both as a source of food and as a temper for pottery.

Summary Statement of the Overall Subsistence Practices of the Sauer Resort Site

It is now possible, based upon the previous animal class discussion, to summarize and evaluate the faunal exploitation at the Sauer Resort site. In the previous discussions emphasis has been placed on that habitat preferences of the species exploited, the quantification of the represented species and evidence of site seasonality. In this summary, intra-class comparisons examine these factors, which are critical to understanding the significance of the Sauer Resort site faunal assemblage. Ultimately, based upon these discussions, it is possible to present a statement of the probable importance of the exploited fauna to the overall subsistence practices of the inhabitants of the Sauer Resort site.

In the previous discussion, it has been demonstrated that the occupants of the Sauer Resort site exploited a variety of habitats in the pursuit of various animal species. These habitats may be generally described as upland and aquatic habitats. In total, 18 upland species are present in the assemblage, while 58 aquatic species are represented. In Table 15, the most valuable animal species in terms of meat yield are hierarchically ranked. This ranking indicates the importance of both upland and aquatic species to the inhabitants of the Sauer Resort site. By examining this table, it may be noted that the most meat is provided by white-tailed deer and elk. Walleye and sauger produced the

Table 15 Hierarchial Ranking of Exploited Species Based Upon Projected Meat Yield

SPECIES	PROJECTED MEAT YIELD (IN POUNDS)	% OF TOTAL MEAT YIELD (ALL CLASSES)
White-tailed deer	1190.0	36.1
Elk/Wapati	650.0	19.7
Walleye/Sauger	408.0	12.4
Black bear	210.0	6.4
Beaver	157.5	4.8
Channel catfish	99.2	3.0
Northern pike	71.0	2.2
Bullhead	54.6	1.6
Raccoon	52.5	1.6
Black bass	42.0	1.3
Sturgeon	36.0	1.3
Dog/Wolf	30.0	.9
Anatinae	24.0	.7
Freshwater drum	21.0	.6
Sunfish/Bluegill	17.2	.5
Snapping turtle	15.0	.5
Bowfin	14.0	.4
Redhorses	13.6	.4
Badger	13.3	.4
Otter	12.6	.4
Woodchuck	11.2	.3
Canada goose	11.2	.3
Aythya sp.	10.0	.3
Misc. Fish	57.5	4.0
Misc. Bird	43.0	
Misc. Mammal	21.3	
Misc. Amphibian/Reptile	9.3	
Total	3295.0	100.2

third most important source of meat. Decreasing in rank, upland and aquatic species alternate, with both habitats equally represented.

In a further attempt to illustrate the relationship between the exploitation of these two environmental zones, Figure 16 compares the upland and aquatic species based upon minimum number of individuals and meat yield. This figure illustrated the relationship between the meat yield and the number of individuals represented. Although relatively few upland mammal individuals are indicated, they represent the largest amount of meat. Represented by numerous individuals, aquatic species supply a lesser amount of meat. Most aquatic species, although small in size per individual, combine to contribute a significant amount of meat. The various collective procurement techniques described for fish and bird species previously, are most probably responsible for the importance of these aquatic resources. It may be generally assumed from this discussion that both upland and aquatic environments were exploited together by the inhabitants of the Sauer Resort site. The location of the site within these two environmental zones, allows for the exploitation of both upland and aquatic species.

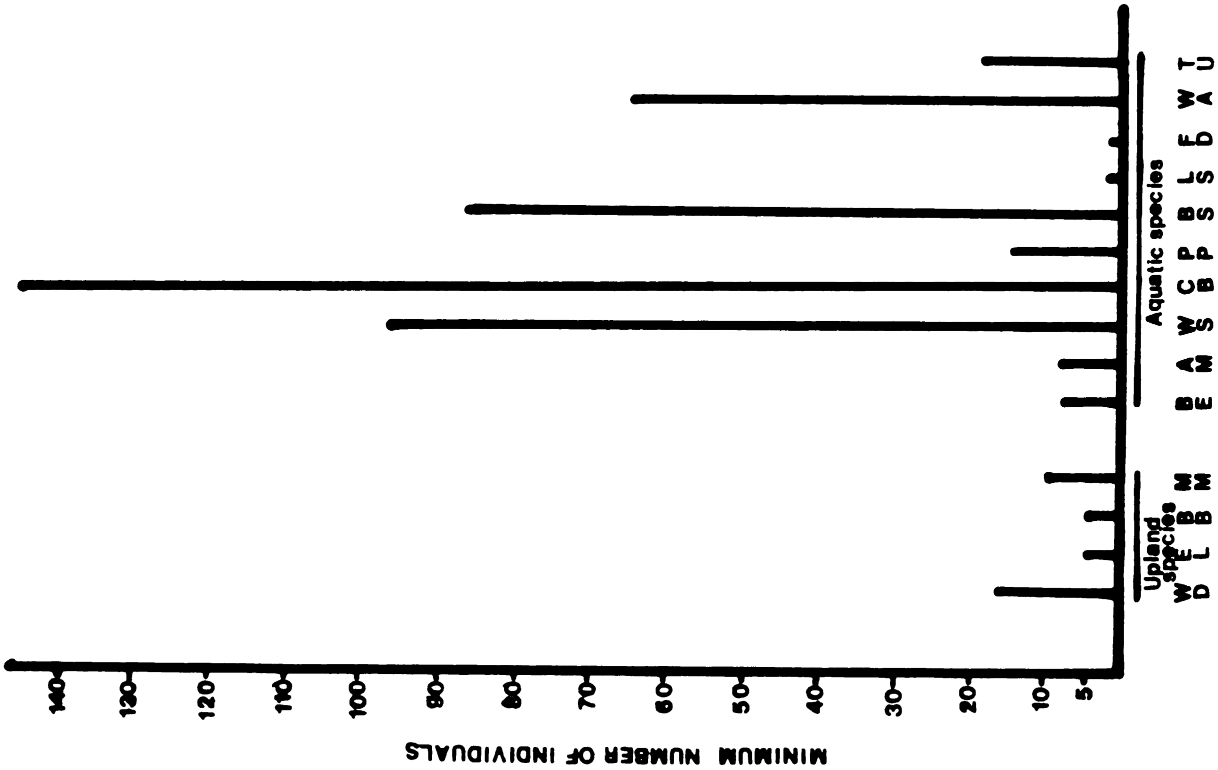
In the previous discussions of the animal species and classes present in the Sauer Resort site assemblage, quantitative data such as the number of specimens identified, the number of individuals represented and the projected meat yield are used to evaluate the significance of both individual species and the animal classes. It is now possible to compare these quantitative factors by animal class in order to evaluate the significance of the entire faunal assemblage. This data is summarized in Table 16.

In the assemblage, a total of 5992 specimens are identified, with 602 individuals represented, with a combined meat yield of 3295 pounds.

Figure 16 Distribution of Exploited Animal Species by Habitat Zone

KEY

WD	White-tailed deer
EL	Elk
BB	Black bear
MM	Medium upland mammals
BE	Beaver
AM	Aquatic mammals (except beaver)
WS	Walleye/Sauger
CB	Catfish/Bullhead
PP	Pike/Pickeral
BS	Black bass/Sunfish/Bluegill
LS	Lake sturgeon
FD	Freshwater drum
WA	Waterfowl
TU	Turtles


MINIMUM NUMBER OF INDIVIDUALS
140
130
120
110
100
90
80
70
60
50
40
30
20
10
5
Upland species
WD
LE
BB
MM
Aquatic species
BE
AM
WS
CB
PP
BS
LS
FD
WA
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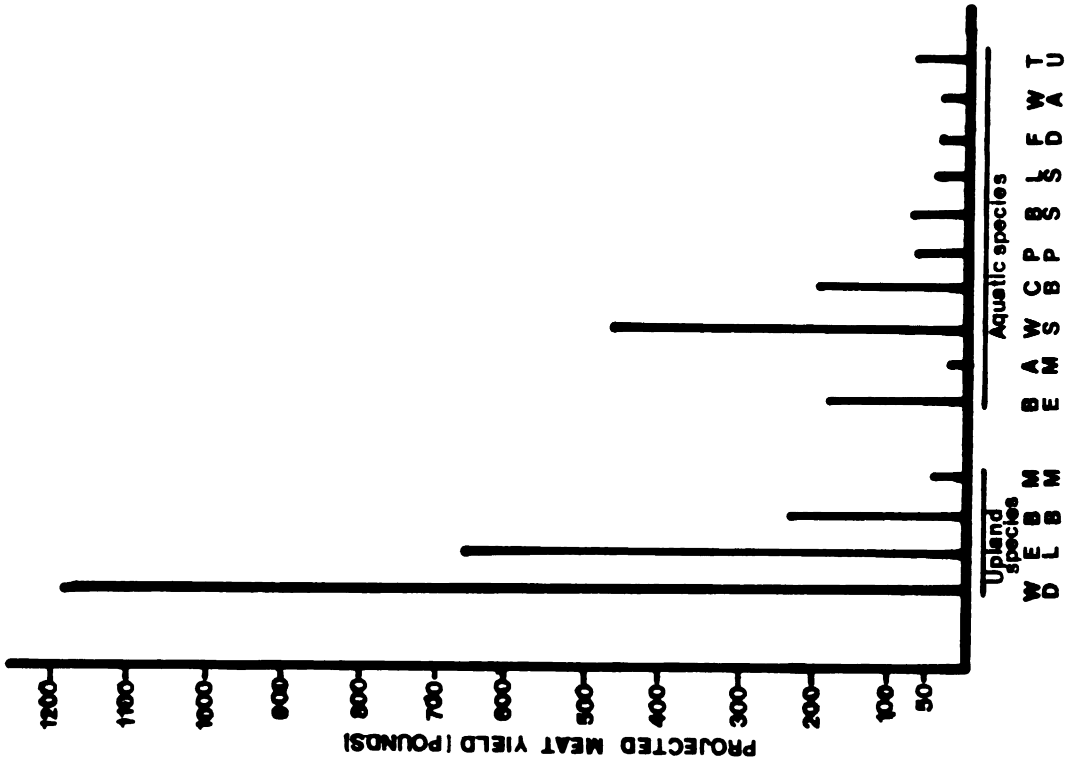
PROJECTED MEAT YIELD (POUNDS)
1200
1100
1000
900
800
700
600
500
400
300
200
100
50
Upland species
WD
LE
BB
MM
Aquatic species
BE
AM
WS
CB
PP
BS
LS
FD
WA
TU

Table 16 Summary of Quantified Data by Class

	PROJECTED MEAT YIELD (POUNDS)	% TOTAL MEAT YIELD	TOTAL # OF SPECIMENS	% TOTAL # OF SPECIMENS	MNI	% TOTAL MNI
MAMMALS	2348.4	71.3	683	11.5	66	11.0
FISH	834.1	25.3	3871	65.1	427	70.9
BIRDS	88.2	2.7	922	15.6	76	12.6
AMPHIBIANS/REPTILES	24.3	0.7	466	7.8	33	5.5
TOTAL	3295.0	100.0	5942	100.0	602	100.0

Although a large amount of individual specimens are noted here, relatively few individuals are present. For example, the mammal class is represented by 66 individuals, however only 41 of these individuals contribute to the subsistence of the site's occupants. Of these 41 individuals, 24 individuals are medium-sized mammals each contributing 30 pounds of meat or less. In the case of the fish assemblage, although 427 individuals are present, many of these individuals are small species such as the ictalurids and centrarchids. A similar situation is true of the avian and reptilian classes.

Differential preservation may be an important influence on the minimum number of individuals represented in a faunal assemblage. This however, is clearly not the case at the Sauer Resort site. A close inspection of the identical anatomical elements from Sauer Resort site (Appendix C) reveals that numerous different anatomical elements are present. Confidence in the minimum number of individuals calculations in the Sauer Resort site may be seen by examining the similarity between the number of left and right elements represented. For example, in the calculation of the number of individual white-tailed deer present in the assemblage either the left or the right mandibles could have been used. This tendancy is even more clearly seen in the fish assemblage. The species walleye/sauger is represented by 85 left dentaries and 85 right dentaries. The MNI calculation for Moxostoma sp. could have used either 13 left maxialla or the 13 right maxilla, and so forth. It is concluded that the MNI calculation may be considered quite reliable since individuals are represented in the assemblage by many different anatomical elements and there is a high correlation between the sided elements for many individuals present in the assemblage.

It is possible based upon the represented fauna to infer the seasonal occupation of the Sauer Resort site. Based upon the identified fauna in this assemblage, occupation between early spring (March) and late fall may be demonstrated. Importantly, no exclusively winter exploited species are identified (ie. white-tailed deer antler shed). The animal species which provide the best evidence for site seasonality are illustrated in Figure 17.

Using the information summarized here, it is possible to produce a probable statement of the importance of faunal resources at the Sauer Resort site. It is apparent from the faunal assemblage that a great variety of faunal resources from a variety of ecological zones are exploited at the Sauer Resort site during different seasons of the year. Although a large variety of resources are exploited, relatively few individuals are represented. Seasonal information indicates that the Sauer Resort site was probably inhabited between early spring and late fall. However, seasonality predictions are often based on negative evidence and are not the best data for determining the relative value of faunal resources as opposed to floral resources. It is argued here that the range of species present and their quantity is the best indication of the relative effort devoted to a fauna based subsistence. Based upon the quantity of individuals present, the nature of faunal exploitation at the Sauer Resort site might be understood as a supplementary resource in a subsistence strategy that depends to a large extent on resources like wild rice or maize. It is difficult to infer the importance of other resources based upon the faunal assemblage, but the represented animal fauna would not have supported many people for very long. Evidence from the artifactual assemblage in the form of discarded hoes, and the proximity to existing garden beds probably indicates that horticultural activities were practiced at the Sauer Resort site.

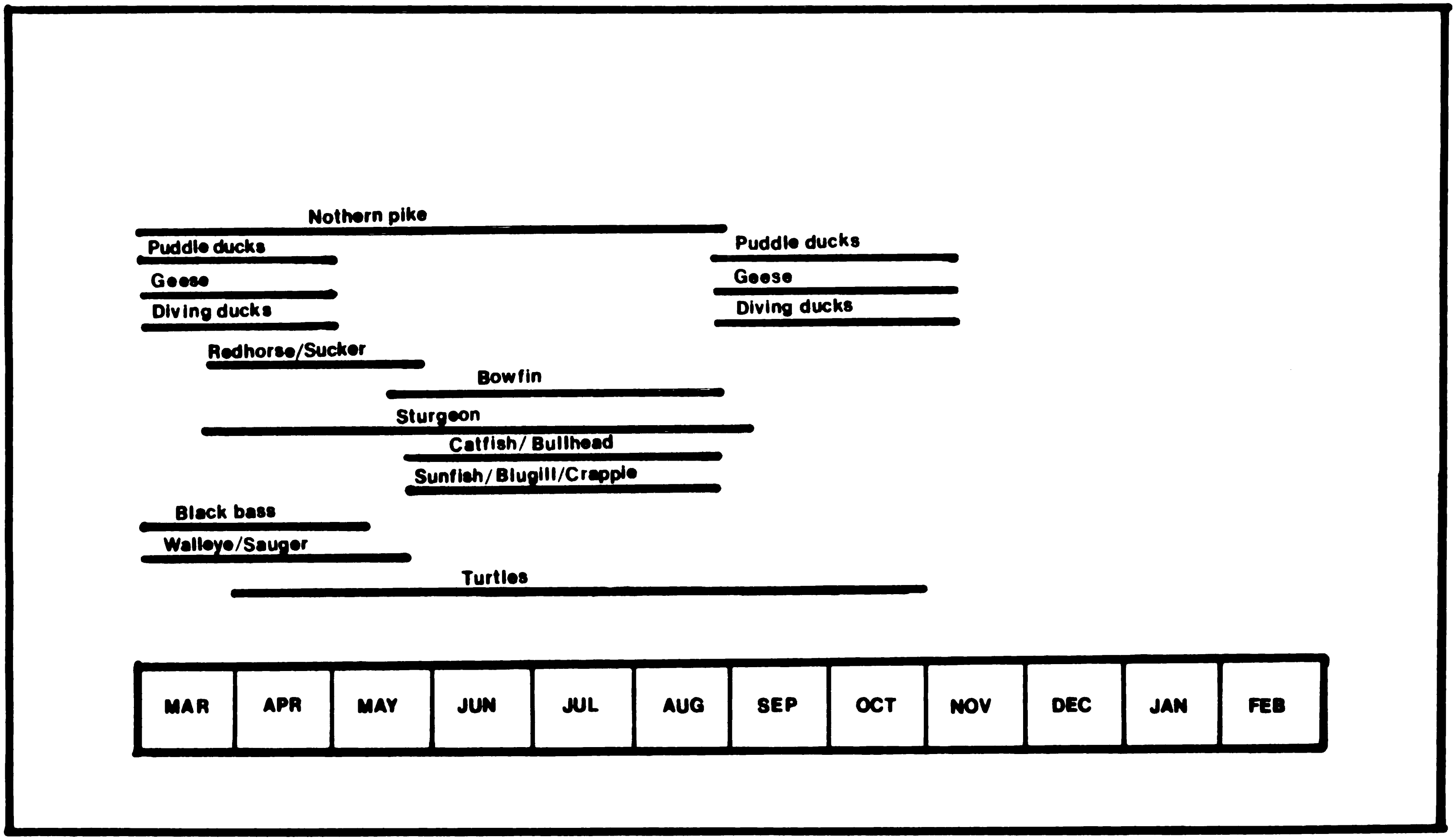

Figure 17 Projected Seasons of Exploitation of Selected Animal Species

In order to present a possible model for the subsistence practices of the Sauer Resort site, ethnohistorical sources may be examined. French Jesuits such as Allouez visiting the Fox-Wolf drainage in the 1670s describe the subsistence practices of the historic Fox Indians. This description of their subsistence practices is as follows:

> They live by hunting during the winter, returning to their cabins towards its close, and living there on Indian corn that they had hidden away the previous Autumn; they season it with fish. In the midst of their clearings they have a Fort, where their cabins of heavy bark are situated, for resisting all sorts of attack (Thwaites 1959:54:223).

Allouez's description of this Fox village on the Wolf River provides a model for the subsistence activities at the Sauer Resort site. In speaking of the planting of corn, he states that the black soil found in this area produced an abundance of corn, which was cached in the late fall and used in the spring, when people return to the village after the winter hunt (Thwaites 1954:54:223).

A tentative model of the subsistence practices of the Sauer Resort site inhabitants would be very similar to Allouez's description of the historic Fox. Based upon the faunal analysis described in this chapter, it is argued that the Sauer Resort site was occupied from early spring through late fall, when people exploited a variety of faunal resources, as well as planted and harvested maize. Animals provided an important supplementary source of food and contributed other important products, especially hides and furs. Fauna was actively pursued and exploited in a variety of different environmental zones by the prehistoric peoples of the Sauer Resort site.

CHAPTER IV

INTERSITE COMPARISONS AND CONCLUSIONS

The opening chapter of this study presented two markedly different synthetic models of Oneota subsistence; those of Cleland (1966) and Overstreet (1978, 1981). Both models have contributed substantially to the problem orientation and direction of the Sauer Resort site analysis, and it is therefore possible to critique and evaluate these models based on their application. This is augmented by intersite comparisons. Because previous discussions have extensively described both the environment and the faunal assemblage of the Sauer Resort site, these data will be invoked where applicable to model evaluation.

Cleland's (1966:97) model proposes an explanation of the five phases of Oneota in Wisconsin based upon differing ecological conditions (different microenvironments) and the degree of utilization of these environments. Relying upon the reconstruction of climate (frost-free days), physiography and ecological zones, Cleland (1966:87) describes the ecological pecularities manifested in these different phases. Much of his interpretation hinges on the Lasley's Point and Carcajou Point assemblages where he argues that the selection of cervids indicates a primarily agricultural economy, with large cervids serving as a supplemental resources.

Employing his well known Focal-Diffuse model, Cleland (1966:82) argues that the Oneota phases of Wisconsin could be considered primarily focal viewed on an evolutionary continuum. Not being as reliant upon maize horticulture as Middle Mississippian populations to the south, Oneota populations exploited a broader resource base with emphasis on a single crop of maize. Importantly, Cleland's (1966) model does not imply Oneota sedentism. Noting the reliance upon maize horticulture, Gibbon (1969), like Cleland (1966) suggests that at the Walker-Hooper site, aquatic resources rather than cervids may have provided a valuable supplement.

Overstreet (1976, 1978, 1981) posits a considerably different interpretation; one based upon uniformity of subsistence and cultural practices through the Oneota cultural continuum. He enlarges the data base with faunal assemblages from the Pipe and Walker-Hooper sites.

Basing his model on Peske (1966, 1971) and Smith (1974), Overstreet (1981:485) argues that the Eastern Ridge and Lowland provinces represent a unique environmental situation. He argues that despite intersite environmental differences, the inhabitants of various Oneota sites exploit similar environs or microenvironments. The pattern of exploitation revolves about six zones exploited to different degrees by the various Oneota populations, producing a "broad spectrum" economy. Using Cleland's (1966) Focal-Diffuse continuum, it is argued that Oneota subsistence data suggest a diffuse rather than a focal economic orientation. Although Overstreet (1981:1178) maintains that Cleland's (1966:44) description of a diffuse economy fits closely with his own model for eastern Oneota, it does differ slightly. In particular it is suggested (Overstreet 1981:479) that viable storage of a wide range of intensively exploited resources would potentially allow Oneota sites to be inhabited throughout the year. This assumption that Oneota sites were occupied throughout the year is an important difference between the two authors.

In summary, Cleland (1966:46) attributes differences between Oneota phases to economics, while Overstreet (1981:485) view these cultural differences as being temporal. According to Overstreet (1981:494), diffuse economics are present throughout the eight hundred years of Oneota prehistory, with an increased reliance upon maize horticulture in the classic horizon (Lake Winnebago phase).

Beginning with these different perspectives, the analysis of the Sauer Resort site began with an indepth paleoenvironmental reconstruction (Chapter II). In a further attempt to assess the selectivity of animal species by the peoples inhabiting the Sauer Resort site, animal species lists were constructed for the site area based upon historical documentation and the paleoenvironmental reconstruction (Appendix B). The end result of these endeavors was a reconstruction of the floral and faunal communities surrounding the Sauer Resort site, indicating a prolific aquatic/upland habitat where a variety and abundance of resources could be exploited.

It has been illustrated in the faunal analysis of the Sauer Resort site that both aquatic and upland habitats are exploited at this site. The importance of the various species within these habitats have been examined based upon the likely season of procurement, the number of individuals represented, and meat yield. Based upon the data described in this analysis it may be argued that the Sauer Resort site represents a specific aquatic/upland adaptation.

When the faunal data is compared with other sites, such as the Pipe, Walker-Hooper, and Lasley's Point sites, similar exploitative patterns are observed (Table 17). Table 17 was constructed by hierarchically ranking the 10 most frequently exploited animal species at these four sites based upon projected meat yield. Since calculation of projected meat yield per individual varied in each faunal analysis, the meat yield

Table 17 Hierarchial Ranking of Ten Most Exploited Animal Groups at Four Oneota Sites

Pipe			Walker-Hooper			Lasley's Point			Sauer Resort Site		
Species	Projected Meat Yield	%	Species	Projected Meat Yield	%	Species	Projected Meat Yield	%	Species	Projected Meat Yield	%
White-tailed deer	1870	36.2	White-tailed deer	2465.0	29.6	White-tailed deer	3740.0	39.1	White-tailed deer	1190.0	41.2
Black bear	1050.0	20.3	Freshwater drum	2169.0	26.1	Elk/Wapati	3250.0	34.0	Elk/Wapiti	650.0	22.5
Elk/Wapati	975.0	18.9	Black bass	1360.0	16.3	Black bear	1260.0	13.2	Walleye	408.0	14.0
Freshwater drum	318.0	6.2	Elk/Wapati	650.0	7.8	Sturgeon	468.0	4.9	Black bear	210.0	7.3
Beaver	283.5	5.5	Bullhead	475.8	5.7	Beaver	378.0	3.9	Beaver	157.5	5.4
Sturgeon	216.0	4.2	Pike	457.1	5.5	Dog/Wolf	240.0	2.5	Channel catfish	99.2	3.4
Raccoon	210.0	4.1	Trout	245.0	3.0	Raccoon	105.0	1.1	Northern pike	71.0	2.5
Catfish	121.6	2.4	Black bear	210	2.5	Walleye	54.0	.6	Bullhead	54.6	1.9
Walleye	67.2	1.3	Beaver	157.5	1.9	Muskrat	42.0	.4	Raccoon	52.5	1.8
Suckers	55.2	1.1	Sunfish/Bluegill/ Crappie	135.2	1.6	Canada goose	39.2	.4			
Total	5166.5	100.2		8324.6	100.0		9576.2	100.1		2892.8	100.0

per individual calculations used in the Sauer Resort site analysis were also used for the Pipe, Walker-Hooper, and Lasley's Point sites. These sites were chosen because they represent large faunal assemblages, giving a better indication of the importance of various resources. The Carcajou Point assemblage was not considered because of its small size. In examining Table 17 it appears that both upland and aquatic resources were exploited at these four sites.

How well, then, does the Sauer Resort site data fit the models proposed by Cleland (1966) and Overstreet (1978, 1981)? It is possible based on the paleoenvironmental reconstruction and faunal analysis of the Sauer Resort site to accept portions of both of these models. It is argued here that both models present valuable hypotheses which explain the subsistence practices of Oneota populations in eastern Wisconsin.

The Sauer Resort site assemblage indicates that a diversity of animal species were exploited. Commensurate with Cleland's (1966) proposal of cervids-as-supplements, in the case of the Sauer Resort site, white-tailed deer and elk are exploited. However, aquatic species are also critical to the subsistence practices at the site. It has been shown in the faunal analysis that the procurement of aquatic species such as spring spawning fish and migratory waterfowl occurs at a critical time (early spring) when few other resources are available. Overstreet (1981) in his model acknowledges the value of the species diversity present in the various assemblages, but it appears that he may have overestimated the importance of the meat contribution to the total subsistence strategy. It is this over emphasis on faunal resources that makes other hypotheses presented in his model difficult to accept. It is the contention of this author that the diversity of the Sauer Resort site assemblage may be better explained from a different perspective than Overstreet's.

The faunal analysis of the Sauer Resort site illustrates that a multitude of upland and aquatic species were exploited. It has been shown that the greatest diversity of species within these two habitats is found in the aquatic environment (Figure 17). It is hypothesized that the diversity in the aquatic animal species present is a two fold product involving both variability found within this environment and the collective procurement using seine nets to exploit these resources. This results in an extensive exploitation.

Because of a lack of niche sensitivity among exploited upland species at the Sauer Resort site, it is not possible to argue that one microenvironment was exploited for a particular resource. Also, from the number of individuals represented from these habitats it has been argued that individualistic rather than collective techniques were most probably used.

The faunal resources represented at the Sauer Resort site are best viewed as a supplementary resource, based on the number of individuals and total meat yield. It is therefore hypothesized that maize horticulture would most likely be the single most important food resource at the site. The procurement of the faunal resources at this site would take place during periods of the year which would not conflict with the cultivation of maize and other crops. Based on this information, it appears that the Sauer Resort site economy would be primarily focal as Cleland (1966:82) argues for the Lake Winnebago phase Oneota.

In his model, Overstreet (1981) maintains that Oneota sites, such as the Pipe site were occupied throughout the year. Citing the richness of the resource base surrounding the Pipe site, he argues that is <u>could</u> (emphasis mine) have been occupied through the winter. An alternative explanation to the situation at the Pipe site is suggested ethnographically among the Fox and other related groups (Thwaites 1959:54: 205, 223). As stated previously, the Fox would cache corn and other cultigens in the fall, disperse to hunt in the winter, returning to use the caches the following spring. The faunal assemblage from the Sauer Resort site appears to lend support to this alternative exploitation because it represents a spring through fall exploitation.

It is the contention of this author, given the ecological data present in this analysis, that the six zone adaptive scenerio that Overstreet (1981:494) describes is too general. It is possible that temporal differences based on the radiocarbon chronology for the eastern Wisconsin Oneota may be responsible for differences in cultural inventories (ie. ceramic stylization) between phases as Overstreet (1981) claims. However, not enough ecological information is available to support Overstreet's (1981) adaptive model. For example, the inclusion of all forest zones together in Overstreet's (1981) model is too general to describe the conditions at the Sauer Resort site. At least four different forest communities ranging from Northern Lowland forest to the Southern Xeric forests are present in the immediate vicinity of the site. Each of these forest communities share differences in floral and faunal species found within them. By lumping all of these vegetative communities together the relationships between plant and animal communities are not clearly seen. Another illustrative example is the riverine-lacustrine zone. At the Sauer Resort site proximity to the mouth of the Wolf River and Lake Poygan is a considerably different aquatic environment than the Lake Winnebago shores of the Pipe site. Additional research is needed to gain a greater appreciation of the ecological differences between the various Oneota phases. Paleoenvironmental and biomass reconstructions of the Pipe, Walker-Hooper, Lasley's Point and Carcajou Point sites and a biomass reconstruction of the Sauer Resort site may give a better indication of the interaction between humans and their environment. Although this hypothesis must be considered tentative, it is quite possible that environmental factors, such as those suggested by Cleland (1966) may also be responsible for differences in the cultural inventories of the various eastern Wisconsin Oneota sites.

APPENDIX A

APPENDIX A

THE CULTURAL AFFILIATION OF THE SAUER RESORT SITE

The Sauer Resort site (47/WN/207) is located in the SE quarter of the NE quarter of section 36, township 20 north, range 14 east, Winnebago County, Wisconsin. The site is located on a remnant, elevated beach formation of the Later Glacial Lake Oshkosh, which is at the present confluence of the Fox and Wolf rivers (Figure A1). Prior to 1977 the site was occupied by a small homestead comprised of a frame house, barn, and three small outbuildings. The destruction of the barn and subsequent removal of the barn bridge in 1977 led to the discovery of the archaeological site by James Clark, a local amateur archaeologist.

Archaeological reconnaissance of the site began when Clark contacted the Department of Sociology/Anthropology at the University of Wisconsin-Oshkosh in the fall of 1977. Since the archaeologist at UW-Oshkosh, Dr. Alaric Faulkner, was on academic leave in the fall of 1977, the author and Daniel Seurer, then archaeological laboratory assistants at

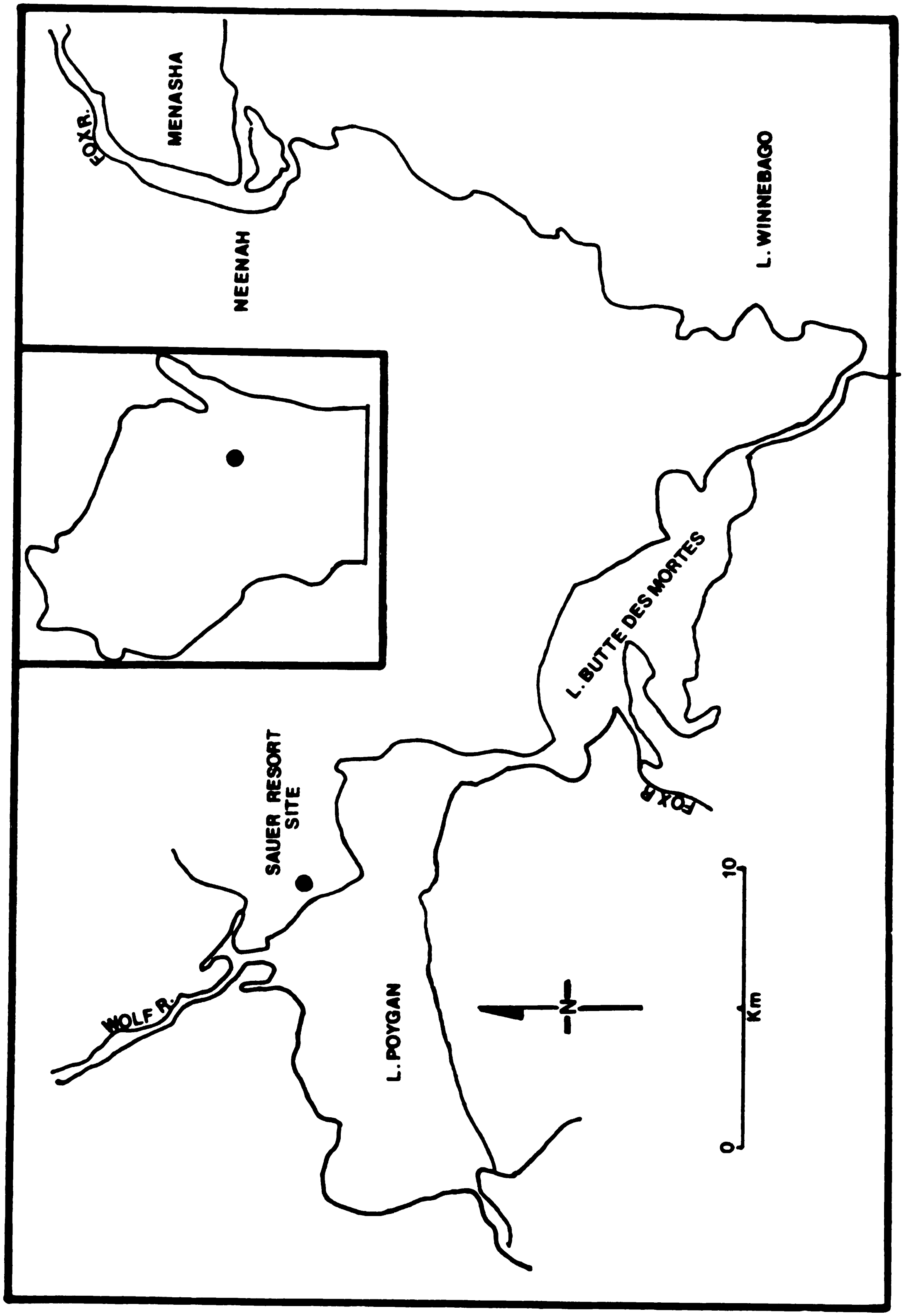

Figure A1 Location of the Sauer Resort Site

UW-Oshkosh, visited the site. Upon completion of a pedestrian survey, the author and Seurer were informed by the landowner, James Sauer that the site was to become an asphalt parking lot the following spring. In order to more thoroughly evaluate the site and to convince the landowner that indeed it was valuable archaeologically, the author and Seurer together with students from UW-Oshkosh and Lawrence University were given permission to open an area of approximately 4 by 4 meters prior to the ground freezing in the fall of 1977. Because of the prolific amounts of materials found during these test excavations, the author and Seurer convinced Mr. Sauer during the winter of 1977-78 to postpone his plans to construct the parking lot and to allow a full-scale excavation of the site the following spring. In the spring of 1978, Dr. Alaric Faulkner under the auspices of the Department of Sociology/Anthropology, University of Wisconsin-Oshkosh, directed a field school at the site, with the author and Seruer serving as field assistants.

Beginning with the 1978 excavations, it was decided that a block excavation of the remaining portion of the site was most desirable. This area was delineated by the previous test excavations in the fall of 1977. Although most of the site had been disturbed by historic construction and utilization, the area directly under the barn bridge promised to be an area least disturbed by this construction. Initially four 2 by 2 meter units (with a 2 meter balk between each unit) were opened on a north-south baseline (Figure A2). These units were designated A through D, with unit A being the furthest north. Subsequent to the excavation of these units, four 2 x 2 meter units were excavated between the previous units (E, F and H) forming a transect of the area. Unit G however, was located west of unit F in order to evaluate the density of materials west of the transect. All units were excavated by trowel in 10 cm.

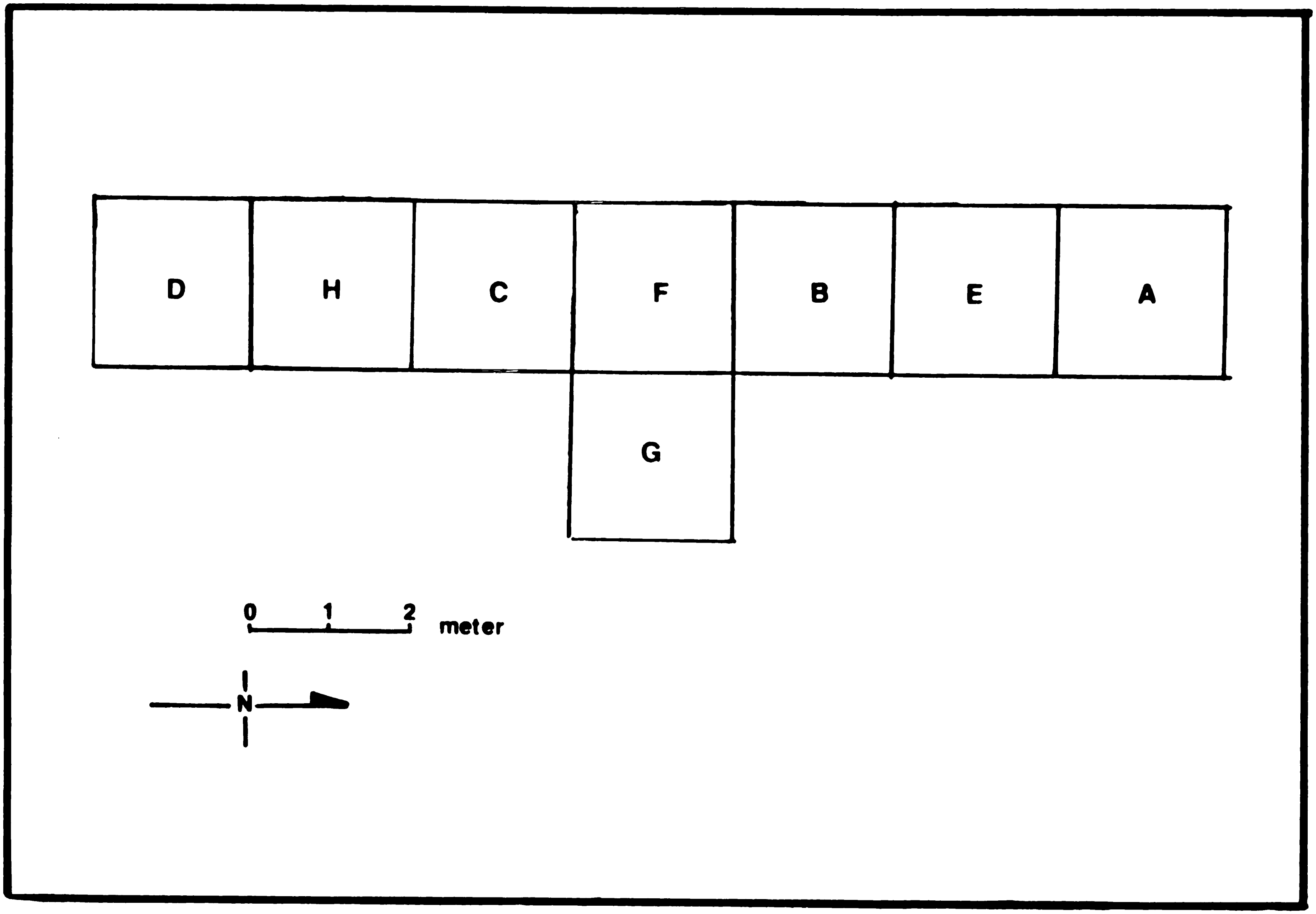

Figure A2 Plan View of the 1978 Excavation of the Sauer Resort Site arbitrary levels to sterile soil, dry screening all soils through one-quarter inch hardware cloth. All artifacts, such as bone tools, identifiable rim sherds, and lithics were piece-plotted on plan maps for each level. All features were recorded and separated from the associated midden deposits. Soil samples were also removed from each arbitrary level and feature for flotation. At the completion of the north-south transect, the west wall was profiled.

The 1978 excavation yielded a great quantity of ceramic, lithic and faunal materials. The ceramics excavated in 1978 have been described by Joan Raney (1979), a student at UW-Oshkosh, with assistance from Daniel Seurer (UW-Madison). The bone artifacts have been analyzed by Victoria Dirst of UW-Oshkosh (1979). These data, as well as the faunal remains from the 1978 excavation provide the data base for this thesis.

In the spring of 1979, Victoria Dirst conducted a field school at the site. This excavation consisted of a transect of 2 x 2 meter units east of the transect excavated in 1978. Based on the 1979 field season, the materials excavated in 1978 represent approximately 50 percent of the undisturbed portion of the site. The disturbed nature of the site does not allow for an accurate assessment of the areal extent of this site. Because of the great amount of materials excavated and the significance of the associated cultural proveniences, only the materials from the 1978 excavation are described in this thesis.

Stratigraphic and Cultural Relationships

In order to appreciate the importance of the problem orientation of this thesis, it is imperative to here describe the stratigraphic and cultural relationships of the archaeological materials excavated at the Sauer Resort site during the 1978 season. This description outlines the stratigraphic relationships between the intensively deposited sheet midden, related features, and associated ceramics. This ceramic description should not be construed as an in depth ceramic analysis, but rather illustrates generally the cultural relationships of the site.

As described previously, the Sauer Resort site was excavated using arbitrary 10 cm levels recorded as successive units from an arbitrary datum point. This datum point, located at the south west corner of the excavation was assigned an arbitrary elevation of 10.00 meters, with the first arbitrary level designated Level 10. In so doing, if levels were excavated upslope from the datum, they would retain a positive number, thus reducing confusion. In the case where cultural and natural stratigraphy became apparent, it was duly noted. This practice is similar to excavation techniques described in Hester, Heizer and Graham (1975).

Based on the examination of the entire west wall profile, the south-north transect may be divided into two distinct stratigraphic sequences, with D, H, C, F, and G (southern most units) indicating one sequence and units B, E and A (northern most units) illustrating a second sequence. The following description discusses the interrelationships of these sequences.

The west wall profile of the southern sequence illustrated by Figure A3, although stratigraphically complex from a cultural perspective, represents soils from only one geomorphic zone. All seven culturally modified zones, IC through IV, are composed of finely sorted, homogeneous glacial beach sand. This area represents a dune activity of the Later Glacial Lake Oshkosh (McKee and Laudon 1972). The northern sequence represents five culturally modified zones (Figure A4). The matrix of zones IA, IA1 and I1 is composed of finely sorted, homogeneous glacial beach sand. This sand is the same matrix material found in the southern sequence. Zone III, absent in the southern sequence, represents the

Figure A3 KEY

IA	5YR2/2 dark reddish brown to 10YR3/2 very dark grayish brown loose fine sand; non-sticky, slightly plastic. Containing some whole shell and rodent burrows. Gradually smooth boundary to IB.
IB	5YR2/2 dark reddish brown to 5YR2/1 black loose fine sand; non-sticky, slightly plastic, friable when dry, containing numerous rodent burrows. Gradual smooth boundary to II.
IC	10YR3/2 very dark grayish brown fine sand; non-sticky, slightly plastic. Containing extensive shellfish bone, fish scales and related midden, truncated by bulldozer. Abrupt wavy boundary to ID.
ICI	10YR3/2 very dark grayish brown sandy midden (possible refuse pit).
ID	10YR3/1 very dark gray fine sand; non-sticky, slightly plastic. Containing occasional midden deposits and rodent burrows. Boundary obscured by rodent activity.
R	Rodent burrow or krotovina.
IIIA	5YR4/3 reddish brown fine sand; non-sticky, slightly plastic. Containing numerous rodent burrows filled with 5YR5/6 yellowish red loose fine sand and a few rodent burrows with 5YR3/1 very dark grayish fine sand. Apparently a mixture of ID and III materials caused by burrowing. Very abrupt wavy boundary to III.
IIIB	5YR3/3 dark reddish brown moist sand; non-sticky, slightly plastic.
IIIC	5YR3/2 dark reddish brown moist loose sand; non-sticky, slightly plastic.
III	2.5YR3/4-6 dark reddish brown to dark red clay; sticky, plastic; hard to very hard. Containing roots, human-made intrusions and rodent activity. Apparently redeposited glacial outwash. Very abrupt smooth boundary to IV.
IVA	10YR3/4 dark yellowish brown to 10YR3/2 very dark grayish brown fine sand; non-sticky, non-plastic. A broad band (approximately 30 cm thick) or mixed sand from I and IV mixed by burrowing activities.
IVA1	10YR3/2 very dark grayish brown fine sandy midden (refuse pit?). Containing shell, charcoal, ash and fish bone.
IV	7.5YR6/6 reddish yellow loose sand, homogeneous to at least the water table.

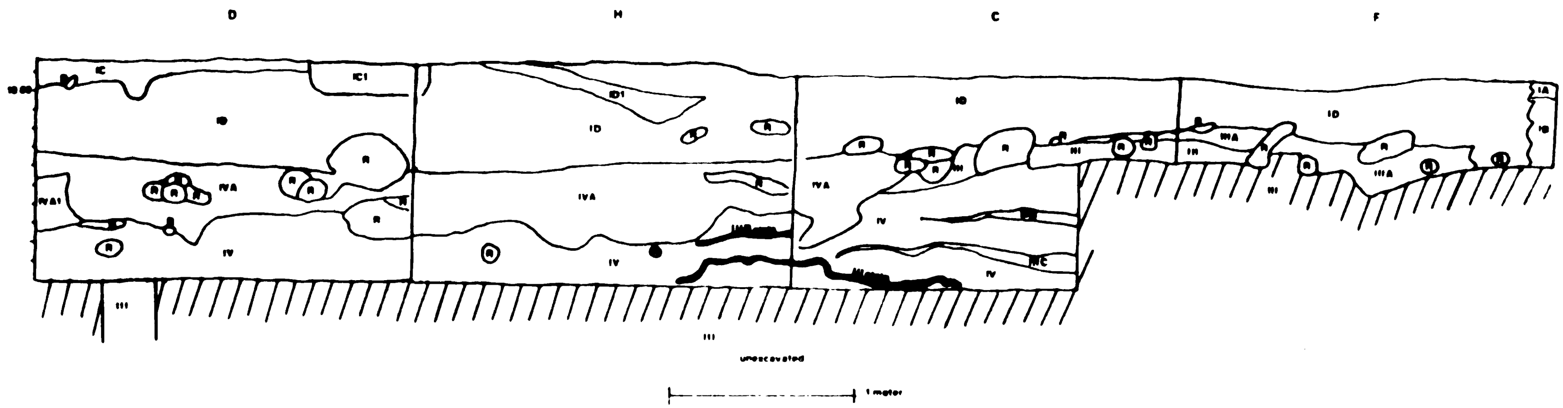

Figure A3 West Wall Profile of Southern Sequence of the Sauer Resort Site

Figure A4 KEY

IA1	7.5YR3/2 dark brown loose fine sand; non-sticky, non-plastic. Minor intrusion into IA.
IA	5YR2/2 dark reddish brown to 10YR3/2 very dark grayish brown loose fine sand; non-sticky, slightly plastic. Containing some whole shell and rodent burrows. Gradually smooth boundary to IB.
IB	5YR2/2 dark reddish brown to 5YR2/1 black loose fine sand; non-sticky, slightly plastic, friable when dry. Containing rodent burrows. Gradual smooth boundary to II.
II	7.5YR5/4-4/4 brown fine sand; non-sticky, non-plastic. Containing rodent burrows and root intrusions. Very abrupt smooth boundary to III.
IIIA	5YR reddish brown fine sand; non-sticky, slightly plastic. Containing numerous rodent burrows filled with 5YR5/6 yellowish red loose fine sand and a few rodent burrows with 5YR 3/1, very dark grayish fine sand. Apparently a mixture of ID and III materials caused by burrowing. Very abrupt wavy boundary to III.
III	2.5YR3/4-6 dark reddish brown to dark red clay; sticky, plastic, hard to very hard. Containing roots, human-made intrusions and rodent activity. Apparently redeposided glacial outwash. Very abrupt smooth boundary to IV.

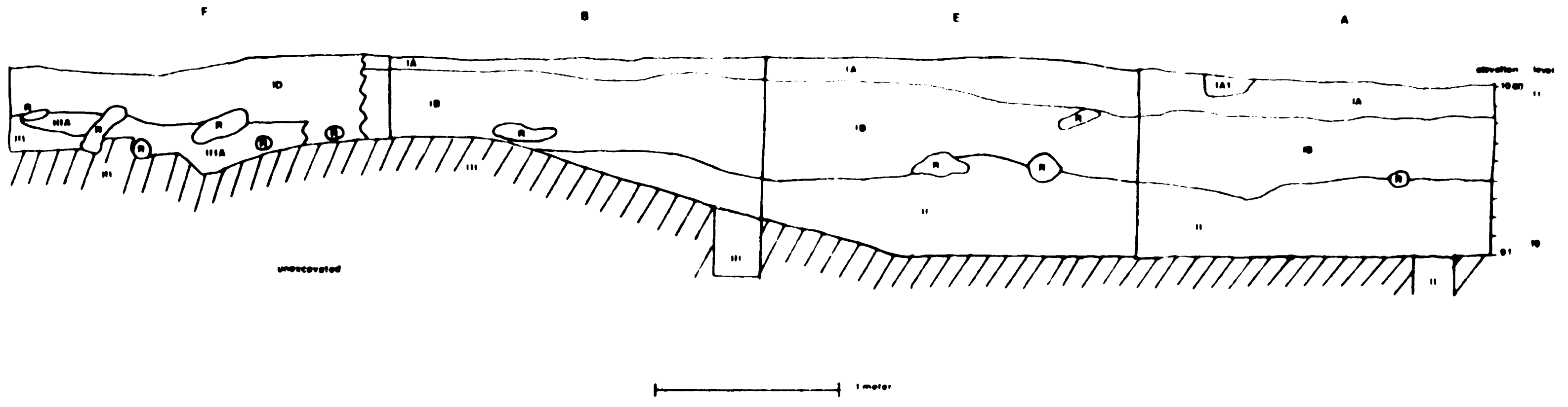

Figure A4 West Wall Profile of the Northern Sequence of the Sauer Resort Site lake bottom of the same episode of Glacial Lake Oshkosh which produced the beach sand matrix. A complete description of the glacial geology of the Fox-Wolf drainage may be found in Chapter II.

In order to interpret the stratigraphic context represented at the Sauer Resort site many factors must be considered. As is the case in most Oneota sites (Overstreet 1976, 1981), areas of this site have been altered by various agents. In discussing the degree of disturbance and/or alteration of the cultural zones, three factors must be considered; 1) Disturbances or alterations at the time of deposition (by humans), 2) Post-depositional disturbances (by agencies other than humans), and 3) Historic and modern alterations of the land surface.

At the time of deposition, various factors influence the cultural materials found in archaeological sites. The amount of people inhabiting an area, their cultural identity, and the length and season of occupation all effect the archaeological record. Factors such as demographics and cultural affiliation are many times difficult to ascertain given the archaeological record. However, using the ceramic and faunal assemblages from the 1978 excavation, this thesis addresses these important issues.

The west wall profile of the south-north transect (Figures A3 and A4) illustrates a large number of rodent runs or krotovina. In the northern sequence, these krotovina are restricted to the second, third and fourth zones (IB, II, III), while they are found throughout the southern sequence. These post-depositional disturbances have greatly altered the cultural stratigraphy of both sequences. The unconsolidated midden deposits allows rodents easy tunneling. This phenomena differs spatially, and is more apparent in the southern sequence, which represents an area of more intensive deposition. In the northern sequence, the sand and clay matrix is much more consolidated, thus making burrowing activities of these animals more difficult.

Without a doubt the most stratigraphically disruptive agency is the intervention of humans using modern earth moving equipment. In Figure A4, a 20 to 25 cm. zone produced by the bulldozing of the barn hill and other grading activities is evident. The upper levels (9, 10, 11 and 12) in units C, G, F, B, E and A have been altered in this manner. It became apparent during excavation of these units that when the barn and barn hill were removed in 1976, the area was graded level for the proposed parking lot. Although the upper levels of units D and H represent primary deposits, materials from this portion of the midden have been redeposited further north. Various factors indicate that this zone (IA) represents fill material from the southern section, units D and H, of the midden. Importantly, this discussion demonstrates that although this deposit is secondary all prehistoric materials must be considered temporally coeval with the primary deposits in units D and H.

Excavation of this upper zone uncovered historic artifacts such as can pop-tops, nails and other miscellaneous scraps of metal. These historic materials resulted from the destruction of the barn and other buildings and became intermixed with the prehistoric materials. Many of these metal artifacts showed little or no evidence of rust illustrating that they had been buried recently. Organic materials such as twigs and leaves in an undecomposed state were also uncovered in this fill zone.

Although the upper zone contains a variety of historic artifacts, a great deal of prehistoric materials were also found. Ceramics of Woodland and Oneota manufacture, identical to materials excavated in the southern sequence were uncovered. Of particular importance to this thesis are the faunal remains uncovered from this zone. Based upon the faunal analysis (see Chapter IV), it is possible to state unequivocally that the animal remains found in this zone are of a prehistoric origin. Although one bone fragment represents a domestic animal species (pig, Sus scrofa), all other species identified were represented in the area prehistorically. If in fact this zone was composed of historic refuse, a variety of pig teeth, chicken bones, and saw cut mammal bone would have been uncovered. None of these materials however, were found in this assemblage. Importantly, one species, the elk (Cervus canadensis) found prehistorically in this region, was not present when the area was first farmed (Jackson 1961). A variety of elk elements have been found in this zone. Mussel shells recovered from this zone also illustrate that they are redeposited from the southern sequence, where a definite shell lens was uncovered. In the northern fill zone, the mussels are found in no apparent stratigraphic position. Based upon this description, the primary and secondary materials excavated from this site must be viewed together as one assemblage.

The density of artifacts uncovered also demonstrates the relationship between the two stratigraphic sequences. As alluded to previously, artifacts in low frequency in the northern sequence are extremely numerous in the southern sequence. Excluding the fill zone (IA), very few artifacts were recovered from the northern sequence. In addition, no features were uncovered in the northern sequence. Although disruption of the upper zone may have destroyed existing features, the artifact density of the lower zone indicates that the northern area of the site was not extensively utilized as the southern area. Whereas no features were uncovered in the northern sequence, seven features as well as primary deposits were noted in units D, H, C, and F. Identification of features in these units was particularly difficult due to rodent activity in the upper zones. However, four isolated, intact features were recognized in unit D, the unit with the highest artifact density. These features appear to be basin-shaped refuse pits characteristic of Oneota occupations. Three other features, (two in Unit C, one in unit H) were also uncovered; however the upper sections of these features have been altered by rodent activity.

Description of the Ceramic Assemblage

It is apparent from the stratigraphic record of the Sauer Resort site that natural factors, such as carnivore and rodent activities, as well as modern earth moving have resulted in post-depositional alteration of the archaeological context. However, cultural activities at the time of deposition are also responsible for the archaeological context of the Sauer Resort site. Various artifact types and styles (i.e. Oneota and Woodland ceramics) have been uncovered at the Sauer Resort site, Pipe site (Overstreet 1976, 1981), Walker-Hooper site (Gibbon 1969, 1972) and Carcajou Point site (Hall 1962). Each of these authors has given different explanations for the stratigraphic or lack of stratigraphic relationships of Late Woodland and Oneota ceramics. Because stratigraphic mixing occurs at these sites, it is difficult to separate artifacts temporally and/or culturally. For example, Overstreet (1981) suggests that the same potters may be producing Oneota and Woodland ceramics at the same site, at the same time. The following discussion addresses the stratigraphic and cultural relationships apparent in the ceramic assemblage from the 1978 excavation.

The ceramic inventory of the Sauer Resort site is extensive. A total of 7919 sherds were recovered from 27.6 cubic meters of excavated matrix. These ceramic materials were counted, weighed and typed by Joan Raney (1979) with the assistance of Daniel Seurer. Raney's (1979) report, although largely descriptive, provides an excellent data base for the discussion of the cultural affiliation of the Sauer Resort site.

Using Raney's (1979) data, an attempt was made to stratigraphically separate the Oneota and Woodland ceramics. The undecorated sherds were separated by the aplastic tempering agent (shell or grit) by count and weight for each arbitrary level. This differentiation of ceramics (and cultures) based on temper is similar to the analyses conducted by Hall (1962), Mason (1966), Gibbon (1969, 1972) and Overstreet (1976, 1981). Using count alone, 6761 sherds were shell-tempered (85%) and 1158 sherds (15%) were grit-tempered. It must be argued however, that a portion of these grit-tempered sherds may have been produced by Oneota peoples (Gibbon 1969, Overstreet 1981).

This relationship between shell (Oneota) and grit (Woodland) has been noted at other Oneota sites. According to Gibbon (1969) and Overstreet (1981), it is difficult to separate shell and grit-tempered sherds, because usually the Woodland sherds are very small with no decoration. This phenomena is also apparent at the Sauer Resort site. At Walker-Hooper, Gibbon (1972a:188), notes 24,921 total sherds comprised of 24,111 shell-tempered sherds (97%) and 810 grit-tempered sherds (3%). At the Pipe site (Overstreet 1976, 1981), 10,633 sherds were recovered, 9527 (90%) of which were shell-tempered and 1106 (10%) of which were grit-tempered. In comparison with the Walker-Hooper site, the Pipe and Sauer Resort sites have a much greater percentage of grit-tempered ceramics.

In order to further evaluate the proportion of shell and grit-tempered ceramics, the frequency of ceramic types is described. Table A1 shows the frequency relations between the shell and grit-tempered ceramic types found at the Sauer Resort site. As indicated, 80% of

Table A1 Frequency of Ceramic Types from the Sauer Resort Site

Type		Number of Identified Sherds	Percent of Total Number (266) of Identified Sherds
Lake Winnebago Trailed		162	61.1
Koshkonong Bold		43	16.6
Carcajou Curvilinear		1	0.4
Allamakee Trailed		1	0.4
Grand River Plain		4	1.5
Lasley's Point Negative Painted		1	0.4
	TOTAL	212	80.0
Madison Cord Impressed		30	11.3
Madison Plain		5	1.9
Madison Folded Lip		2	0.8
Point Sauble Collared		4	1.5
Heins Creek Corded Stamped		3	0.8
Dane Incised		9	3.4
Marion Thick		1	0.4
	TOTAL	54	20.0

the 266 typed sherds are shell-tempered, while 20% are grit-tempered. These percentages are similar to the percentages based upon count (85% shell, 15% grit) of undecorated body sherds. In examining the features with associated ceramics from Sauer Resort, a proportion of shell and grit-tempered sherds is observed (Table A2). Features 10, 12, and 17 are comprised of all (100%) shell-tempered ceramics.

In a further attempt to separate the shell and grit-tempered sherds stratigraphically, a percentage frequency diagram based upon count and weight of the shell and grit-tempered sherds was constructed for each unit excavated. Unfortunately, these diagrams illustrate that the shell and grit-tempered ceramics could not be divided stratigraphically. This lack of stratigraphic separation was also noted at the Pipe site (Overstreet 1981). As described in the discussion of the stratigraphic sequences found at the Suaer Resort site, a great deal of mixing of materials has occured at this site.

Cultural Relationships

Based upon the ceramic analyses of Hall (1962), Gibbon (1969, 1972a) and Overstreet (1976, 1981), the preponderance of shell-tempered ceramics and associated ceramic types indicate that the Sauer Resort site is primarily an Oneota occupation. Since it is impossible to separate the Oneota and Woodland ceramics stratigraphically, it must be argued that although the site is primarily Oneota, associated Woodland affiliations are also apparent. Unfortunately, the complex relationship between Woodland and Oneota cultural systems can not be ascertained based upon the cultural and stratigraphic relationships of the Sauer Resort site.

Within the Oneota continuum (Hall 1962, Overstreet 1976, 1981), the large proportion of Lake Winnebago Trailed ceramics (61.1%) indicates that the Sauer Resort site is a Lake Winnebago phase manifestation.

Table A2 Features and Associated Ceramics of the [illegible] Resort Site (By count)

Table A2 Features and Associated Ceramics of the Sauer Resort Site (By count)

Feature	Number of Sherds	Percentage of shell-tempered sherds	Percentage of grit-tempered sherds	Typed sherds
*10	46	100	0	2 Lake Winnebago Trailed 3 Koshkonong Bold
11	21	95	5	1 Grand River Plain
*12	13	100	0	no typed sherds
*17	11	100	0	no typed sherds
20	15	93	7	1 Lake Winnebago Trailed
22	17	88	12	1 Lake Winnebago Trailed
24	147	94	6	5 Lake Winnebago Trailed 1 Koshkonong Bold 1 Point Sauble Collared

*Intact Oneota Feature

This ceramic type usually represents the highest proportion of any type in Lake Winnebago phase occupations. According to Hall (1962) and Overstreet (1976, 1981), the Lake Winnebago phase represents the Classic horizon in the Oneota continuum, illustrated by increased stylization and uniformity of pattern in ceramic decoration. Overstreet (1981) maintains that the Lake Winnebago phase represents the zenith of Upper Mississippian cultural development.

Importantly, the type known as Koshkonong Bold represents the second greatest percentage frequency. Overstreet (1978, 1981) argues that Koshkonong Bold ceramics may be a transitional type between the Developmental and Classic horizons. Koshkonong Bold ceramics are found in a relatively even distribution throughout the Sauer Resort site. Based upon count or shell and grit-tempered sherds, the Pipe site, a Grand River phase-Developmental horizon occupation, has a similar proportion of grit and shell-tempered sherds to the Sauer Resort site assemblage. Citing the similarity of these two assembalges and the preponderance of Koshkonong Bold ceramics, it may be argued that the Sauer Resort site represents an early Lake Winnebago phase site.

APPENDIX B

APPENDIX B

PREHISTORIC ANIMAL SPECIES OF THE FOX-WOLF DRAINAGE

The following animal species lists were developed for two reasons. Initially, descriptions aid in reconstructing the prehistoric environment of the Fox-Wolf drainage and are useful in the identification of faunal materials from the Sauer Resort site. Secondly, these lists will provide summary information for other zooarchaeologists working in this area of Wisconsin. It must be stressed here that animal communities do not always coincide with plant communities. For instance, animals such as the white-tailed deer (Odocoileus virginianus) are not confined to any particular plant community and range between Northern Michigan and the Gulf Coast. Other animals however, such as the muskrat (Ondatra zibethicus) are restricted to marsh or marsh edge communities. Factors, such as these, are considered in each description.

Mammals

The mammal species (Table B1) was compiled utilizing a variety of historic and modern animal surveys. Beginning in 1852, I. A. Lapham produced the first list of Wisconsin fauna with an updated list published by Moses Strong in 1883. These surveys provide important data in a general sense. Because these lists did not incorporate animal and plant community relationships, they provide little information on regional differences found among mammal groups. The first definitive work concentrating on the interaction of plant and mammal communities was published by Hartley J. T. Jackson (1961). Jackson's surveys began in the early 1900's and concluded with his publication in 1961. Because this survey covers approximately 60 years it provides information about community changes not documented in short term surveys. In concern with William Burt's Mammals of the Great Lakes Jackson's work provides a reasonable data base from which to draw inferences. As is apparent in Table B1, plant communities not associated with the Sauer Resort site have also been included. This has been done to illustrate the range of these mammal species. If conclusions about these species were based solely upon the plant communities represented at the Sauer Resort site, it would present a heavily biased interpretation. Because of this, all the major plant communities as described by Curtis (1959) have been included.

Birds

The following bird species list (Table B2) was compiled using a recent publication entitled Birds of Wisconsin, by Owen J. Gromme (1974). Since birds, unlike most mammals are transient through this area, documented evidence of availability is more important than habitat location. Vegetation affiliation for this species list has been confined to "Aquatic", "Marsh/Aquatic" and "Upland" designations. This list incorporates only bird species that are archaeologically significant. Small song birds, such as the zoological order Passiformes, are rarely found in archaeological assemblages and when they do occur are not considered to be important from a subsistence standpoint.

Amphibians and Reptiles

The Amphibian and Reptile species list was developed using an excellent recent publication entitled Natural History of Amphibians and Reptiles in Wisconsin, by Richard C. Vogt (1981) (Table B3). This survey documents each species and its corresponding habitat. It is particularily valuable because Vogt (1981) utilizes the plant community classifications described by Curtis (1959). Amphibian and reptiles are often overlooked by zooarchaeologists, but are exceptionally good indicators of climate and environment because of their ecological sensitivity.

Freshwater Mollusca

The following list of freshwater mollusca species is derived from The Freshwater Mollusca of Wisconsin by Frank Baker (1928) (Table B4). Baker's surveys concentrated primarily upon the Fox River and Lake Winnebago, with only a passing mention of the Wolf River drainage. Because the Wolf and Fox Rivers are similar in flowage patterns, it is possible to assume that species found in the Fox would be represented in the Wolf for the most part. Where this can not be stated unequivocally, special note is made (*).

Fish

The fish species list is based on a survey conducted by C. Willard Greene (1935) entitled, The Distribution of Wisconsin Fishes, with verification by Hubbs and Lagler (1967) (Table B5). As in the case of the freshwater mollusca (Baker 1928), Greene's (1935) survey pays particular attention to the Fox drainage and little attention to the Wolf. Where

Table B1 Mammal Species of the Fox-Wolf Drainage

	HABITATS														
Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Didelphis m. virginianus Opossum			X				X	X	X						
Sorex c. cinereus Cinereous shrew		X	X				X			X				X	
Sorex cinereus leseurii Indiana cinercous shrew		X	X				X			X				X	
Sorex acticus laricorum Southern saddle-backed shrew		X					X							X	
Blarina b. brevicauda Giant mole shrew		X	X			X								X	X
Blarina b. kirtlandi Lakes state mole shrew		X	X			X								X	X
Scalopus aquaticus machrinus Prairie mole				X			X			X		X	X		
Myotis l. lucifugus Little brown bat			X	X			X			X					X

Table B1 Continued

Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
							HABITATS								
Myotis keeni septentrionalis Eastern long-eared bat			X	X			X			X					X
Lasionycteris noctivagans Silver-haired bat								X	X						
Eptesicus fuscus Big-brown bat			X	X				X	X						
Lasiurus borealis Hairy-tailed bat			X	X		X			X	X					
Lasiurus c. cinereus Hoary bat	X	X			X										
Lepus townsendii campanius White-tailed jack rabbit					X	X						X	X		
Lepus americanus phaeonotus Minnesota varying hare		X	X		X		X							X	X

Table B1 Continued

Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
	HABITATS														
Sylvilagus floridanus Cottontail rabbit		X				X	X				X	X		X	
Marmota m. monax Southern woodchuck	X	X	X		X	X	X							X	X
Marmota m. rufescens Rufescent woodchuck	X	X	X		X	X	X							X	X
Citellus t. tridecemlineatus Striped ground squirrel				X	X					X		X	X	X	
Citellus franklinii Franklin's ground squirrel				X	X		X							X	X
Tamias striatus giseus Gray chipmunk				X						X				X	X
Eutamias minimus jacksoni Wisconsin least chipmunk			X		X		X			X				X	X
Scriurus carolinensis Gray squirrel		X	X	X	X		X			X					X

Table B1 Continued

Name	HABITATS Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Scriurus niger rufiventer Western fox squirrel		X	X	X		X				X					
Tamiasciurus hudsonicus minnesota Red squirrel		X	X		X					X					
Glaucomys v. volans Southern flying squirrel			X	X				X		X					
Glaucomys sabrinus macrotis Northern flying squirrel		X	X		X					X					
Castor canadensis michiganensis Michigan beaver		X	X				X							X	X
Peromyscus maniculatus gracilis Woodland deer mouse		X	X		X		X								

Table 81 Continued

Name	HABITATS														
	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Peromyscus maniculatus bairdii Prairie deer mouse						X						X	X	X	
Peromyscus leucopus Northern white-footed mouse			X	X	X	X		X	X						
Synatomys c. cooperi Lemming mouse		X	X				x						X	X	
Clethrionomys g. gapperi Gapper's red-backed vole		X	X		X									X	
Microtus p. pennsylvanicus Meadow vole		X					X				X			X	X
Microtus o. ochrogaster Prairie vole												X	X		
Ondatra z. zibethicus Common muskrat		X					X				X				X

Table B1 Continued

Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
	HABITATS														
Zapus h. hudsonius Hudsonian meadow jumping mouse		X					X							X	
Erethizon d. dorsatum Canada porcupine	X	X	X	X	X	X		X	X	X				X	
Canis latrans thamnos Northeastern coyote		X	X									X	X	X	
Canis lupus lycaon Eastern wolf		X	X									X	X	X	
Vulpes f. fulva Eastern red fox	X				X	X						X	X	X	
Urocyon cinereoargenteus ocythous Wisconsin gray fox			X	X	X	X	X	X		X					X
Euarctos americanus americanus Black bear			X	X		X				X					

Table B1 Continued

Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Procyon lotor hirtus Upper Mississippi valley raccoon		X	X		X	X	X		X		X			X	X
Martes a. americana American marten		X	X		X		X								
Martes p. pennanti Fisher		X	X		X		X							X	X
Mustela erminea bangsi Ermine		X	X		X		X							X	
Mustela rixosa allegheniensis Allegheny least weasel		X									X			X	
Mustela frenata noveboracensis New York long-tailed weasel		X	X				X							X	X

Table B1 Continued

Name	HABITATS														
	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Mustela vison letifera Upper Mississippi valley mink		X					X							X	X
Gulo luscus luscus Wolverine			X	X	X			X	X	X					
Taxidea taxus jacksoni Jackson's badger		X										X	X	X	
Mephitis mephitis hudsonica Northern plains skunk		X	X	X	X			X	X	X				X	
Lutra c. canadensis Canada otter		X					X				X			X	X
Felis concolor schorgeri Wisconsin puma			X	X	X	X			X	X		X	X		X
Lynx c. canadensis Canada lynx	X	X	X	X				X	X	X				X	

Table B1 Continued

Name	HABITATS														
	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Lynx rufus superiorensis L. superior bobcat		X	X				X		X					X	X
Cervus c. canadensis American elk		X	X			X					X	X		X	
Odocoileus virginianus borealis Northern white-tailed deer		X	X	X	X	X		X	X	X				X	
Alces alces andersoni Northwestern moose	X	X	X											X	X
Bison bison Plains buffalo						X						X	X		

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

Name	Habitat	Visitant				Resident			
		Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Gavia immer Common loon	Aquatic	common transient	common transient		common transient	fairly common (nesting)		rare	
Podiceps auritus Horned grebe	Aquatic	fairly common transient	fairly common transient	rare	fairly common transient	rare			
Podiceps grisegena Red-necked grebe	Aquatic	rare transient	rare transient		rare transient	very rare			
Podilymbus podiceps Pied-billed grebe	Aquatic	common transient	common transient	common transient	common transient	common to abundant (nesting)	common	rare	common
Phalacrocorax auritus Double-crested cormorent	Drowned bottomland forest/ Aquatic	uncommon transient	uncommon transient		uncommon transient	uncommon to rare (nesting)			
Nycticorax nycticorax Black-crowned night heron	marsh/ aquatic	common transient	common transient		common transient	common (nesting)		rare	
Casmerodius albus Great egret	marsh/	fairly common transient				uncommon (nesting)			
Nyctanassa violacea Yellow-crowned night heron	marsh/ aquatic					rare			

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

Name	Habitat	Visitant Summer	Visitant Fall	Visitant Winter	Visitant Spring	Resident Summer	Resident Fall	Resident Winter	Resident Spring
Butorides striatus Green heron	marsh/ aquatic					common (nesting)			
Florida caerulea Little blue heron	marsh/ aquatic	rare							
Egretta thula Snowy egret	marsh aquatic	rare							
Ixobrychus exilis Least bittern	marsh/ aquatic					fairly common (nesting)			
Botaurus lentiginosus American bittern	marsh/ aquatic	common transient	common transient		common transient	common (nesting)		rare	
Olor columbianus Whistling swam	marsh/ aquatic		common transient						
Branta canadensis Canada goose	marsh/ aquatic	common transient	common transient	common transient	common transient	uncommon (nesting)	common	uncommon- common	
Chen caerulescens Snow goose	marsh/ aquatic		fairly common transient		uncommon transient			very rare	
Anser albifrons White-fronted goose	marsh/ aquatic		rare transient		rare transient				
Branta bernicla Brant	marsh/ aquatic		very rare transient		very rare transient				

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

		Visitant				Resident			
Name	Habitat	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Anas rubripes Black Duck	marsh/ aquatic	common transient	common transient	common transient	common transient	fairly common (nesting)	fairly common	fairly common	fairly common
Anas platyrhynchos Mallard	marsh/ aquatic	abundant transient	abundant transient	abundant transient	abundant transient	common (nesting)		fairly common	
Mereca penelope European wigeon	marsh/ aquatic				rare transient				
Mereca americana American wigeon	marsh/ aquatic	common transient	common transient		common transient				
Anas strepera Gadwall	marsh/ aquatic	fairly common transient	fairly common transient		fairly common transient				
Anas crecca Green-winged teal	marsh/ aquatic	fairly common transient	fairly common transient		fairly common transient	uncommon (nesting)		rare	
Anas discors Blue-winged teal	marsh/ aquatic	abundant transient	abundant transient		abundant transient	common (nesting)		very rare	
Anas acuta Pintail	marsh/ aquatic	common transient	common transient		common transient	uncommon (nesting)		rare	
Aix sponsa Wood duck	marsh/ aquatic	fairly common transient	fairly common transient		fairly common transient	fairly common (nesting)		very rare	

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

		Visitant				Resident			
Name	Habitat	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Anas clypeata Northern shoveler	marsh/ aquatic	fairly common	fairly common transient		fairly common transient	uncommon (nesting)		rare	
Aythya marila Greater scaup	marsh/ aquatic		fairly common transient		fairly common transient				
Aythya valisineria Canvas back	marsh/ aquatic		fairly common transient		fairly common transient	rare		uncommon	
Aythya americana Redhead	marsh/ aquatic	fairly common visitant				uncommon (nesting)		rare	
Aythya collaris Ring-necked duck	marsh/ aquatic	common transient	common transient		common transient	uncommon (nesting)		rare	
Aythya affinis Lesser scaup	marsh/ aquatic	common transient	common transient	common transient	common transient	rare (nesting)		fairly common	
Bucephala clangula Common goldeneye	marsh/ aquatic (open water)		common transient	common transient	common transient	uncommon (nesting)		common	
Oxyura jamaicensis Ruddy duck	marsh/ aquatic (open water)	fairly common transient	fairly common transient		fairly common transient	uncommon (nesting)		rare	

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

		Visitant				Resident			
Name	Habitat	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Lophodytes cucullatus Hooded merganser	aquatic	fairly common transient	fairly common transient	rare	fairly common transient	uncommon (nesting)		rare	
Mergus serrator Red-breasted merganser	aquatic	fairly common transient	fairly common transient	fairly common transient	fairly common transient	common (nesting)		uncommon	
Mergus merganser Common merganser	aquatic	common transient	common transient	common transient	common transient	uncommon (nesting)		common	
Cathartes aura Turkey vulture	marsh/ aquatic	uncommon transient	uncommon transient		uncommon transient	uncommon (nesting)			
Buteo lagopus Rough-legged hawk	marsh/ aquatic		fairly common transient	fairly common transient	fairly common transient			fairly common	
Circus cyaneus Marsh hawk	marsh/ aquatic	common transient	common transient	common transient	common transient	common (nesting)		uncommon	
Accipiter striatus Sharp-shinned hawk	upland	common transient	common transient	common transient	common transient	uncommon (nesting)		uncommon	
Accipiter cooperii Cooper's hawk	upland	common to abundant transient	common to abundant transient	common to abundant transient	common to abundant transient	uncommon (nesting)		uncommon	
Accipiter gentilis Goshawk	upland	uncommon transient	uncommon transient	uncommon transient	uncommon transient		uncommon permanent		

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

		Visitant				Resident			
Name	Habitat	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Buteo jamaicensis Red-tailed hawk	upland	common to abundant transient	common to abundant transient	common to abundant transient	common to abundant transient	common	common	fairly common	common (nesting)
Buteo lineatus Red-shouldered hawk	upland	fairly common transient	fairly common transient	fairly common transient	fairly common transient	fairly common		uncommon	fairly common (nesting)
Buteo platypterus Broad-winged hawk	upland	common transient	common transient		common transient	rare fairly common (nesting)			
Haliacetus leucocephalus Bald eagle	upland	uncommon transient	uncommon transient	uncommon transient	uncommon transient	uncommon (nesting)		uncommon	
Aquila chrysaetos Golden eagle	upland		rare transient	rare transient	rare transient			uncommon	
Falco peregrinus Peregrine Falcon	upland	uncommon transient	uncommon transient		uncommon transient	rare			(nesting)
Falco sparverius American kestrel	upland	common transient	common transient	common transient	common transient	fairly common (nesting)		uncommon	
Bonasa umbellus Ruffed grouse	upland								

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

		Visitant				Resident			
Name	Habitat	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Tympanuchus cupido Greater Prairie	upland prairie					abundant	abundant	abundant	abundant (nesting)
Colinus virginianus Bobwhite	upland					(nesting)	Fairly common permanent		
Perdix perdix Gray partridge	upland					(nesting)	Fairly common permanent		
Meleagris gallopavo Turkey	upland						common permanent		(nesting)
Ardea herodins Great Blue heron	marsh/ aquatic	common transient	common transient		common transient	fairly common (nesting)		rare	
Grus americana Whooping crane	marsh aquatic	uncommon transient	uncommon transient		uncommon transient				
Grus canadensis Sandhill crane	marsh/ aquatic	uncommon transient	uncommon transient		uncommon transient	rare			(nesting)
Rallus elegans King rail	marsh/ aquatic					common (nesting)			
Porzana carolina Sora	marsh/ aquatic	common transient	common transient		common transient	common			
Rallus limicola Virginia rail	marsh/ aquatic	fairly common	fairly common		fairly common	(nesting) fairly common to common			

Table B2 Bird Species Found Within the Fox-Wolf Drainage (Archaeologically significant)

		Visitant				Resident			
Name	Habitat	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Gallinula chloropus Common gallinule	marsh/ aquatic					fairly common (nesting)			
Fulica americana American coot	marsh aquatic	abundant transient	abundant transient	abundant transient	abundant transient	fairly common to common (nesting)		rare	
Bartramia longicauda Upland sandpiper	upland	fairly common transient	fairly common transient		fairly common transient	fairly common (nesting)			
Philohala minor American woodcock	marsh aquatic	fairly common transient	fairly common transient		fairly common transient	fairly common			(nesting)
Capella gallinago Common snipe	marsh aquatic	fairly common transient	fairly common transient	fairly common transient	fairly common transient	uncommon to fairly common (nesting)		rare	
Larus delawarensis Ring-billed gull	marsh/ aquatic	common transient	common transient		common transient	fairly common (nesting)		fairly common	
Sterna hirundo Common tern	marsh/ aquatic	common transient	common transient		common transient	fairly common (nesting)			

Table B2 **Bird Species Found Within the** Fox-Wolf Drainage (Archaeologically significant)

Name	Habitat	Visitant Summer	Fall	Winter	Spring	Resident Summer	Fall	Winter	Spring
Chlidonias niger Black tern	marsh/ aquatic	common transient	common transient		common transient	common to abundant (nesting)			
Ectopistes migratorius Passenger pigeon	upland					(nesting)	abundant permanent		
Zenaidura macroura Mourning dove	upland	common transient	common transient		common transient	common (nesting)		uncommon	
Strix varia Barred owl	upland						fairly common permanent		(nesting)
Bubo virginianus Great horned owl	upland						common permanent		(nesting)
Corvus brachyrhynchos Common crow	upland						abundant permanent		(nesting)
Melanerpes erythrocephalus Red-headed woodpecker	upland	common	common	common	common	common perman. (nesting)	common perman.	uncommon perman.	common perman.
Melanerpes carolinus Red-bellied woodpecker	upland					fairly common to perman. (nesting)	fairly common to perman.	fairly common to perman.	fairly common to perman.
Colaptes auratus Yellow-shafted flicker	upland	common transient	common transient	common transient	common transient	common perman. (nesting)	common perman.	common perman.	common perman.

Table B2 **Bird Species Found Within the Fox-Wolf Drainage** (Archaeologically significant)

		Visitant				Resident			
Name	Habitat	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Picoides pubescens Downy woodpecker	upland					common perman. (nesting)	common perman.	common perman.	common perman.
Sphyrapicns varius	upland	common transient	common transient		common transient	fairly common (nesting)		rare	
Picoides villosus Hairy woodpecker	upland					common perman. (nesting)	common perman.	common perman.	common perman.

Table B3 Amphibians and Reptile species of the Fox-Wolf Drainage

	HABITATS													
Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Bufo americanus americanus Eastern American Toad		X				X	X		X			X			X
Aeris crepitans blanchardi Blanchard's cricket frog		X					X								X
Pseudacris triseriata Western chorus frog		X									X				X
Hyla crucifer Northern spring peeper		X													X
Hyla chrysosoelis Cope's gray treefrog		X		X		X									X
Hyla versicolor Eastern gray treefrog	X		X	X				X	X						X
Rana catesbeiana Bullfrog						Any permanent water									X

Table B3 Continued

Name	HABITATS Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Rana clamitans melanota Green frog							Any permanent water								X
Rana pipiens Northern leopard frog		X					X				X				X
Rana sylvatica Wood frog	X	X	X				X				X				X
Chelydra serpentina Common snapping turtle							Any permanent water								X
Emydoidea blandingi Blanding's turtle		X					X				X				X
Chrysemys picta Painted turtle		X									X				X
Graptemys geographica Map turtle		X									X				X
Graptemys pseudogeographica False Map turtle		X													X

Table B3 Continued

	HABITATS														
Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
<u>Trionyx</u> <u>spiniferus</u> Eastern spiny softshell turtle		X					X								X
<u>Eumeces</u> <u>fasciatus</u> Five-lined skink				X	X	X									
<u>Diadophis</u> <u>punctatus</u> <u>edwardsi</u> Northern Ringneck snake			X												
<u>Heterodon</u> <u>platyrhinos</u> Eastern Hognose snake						X					X		X		
<u>Opheodrys</u> <u>vernalis</u> Smooth green snake					X	X					X	X			
<u>Elaphe</u> <u>vulpina</u> Western fox snake					X	X									
<u>Pituophis</u> <u>melanohucus</u> <u>sayi</u> Bullsnake					X	X							X		

Table 83 Continued

	HABITATS														
Name	Boreal Forest	Lowland Northern Forest (swamp conifer)	Mesic Northern Hardwood Forest	Dry and Dry Mesic Northern Hardwood Forest	Pine Forests	Oak Barrens and Oak Openings	Sedge Meadow	Southern Wet and Southern Wet-Mesic Forest	Southern Mesic Forest	Southern Dry and Southern Dry-Mesic Forest	Wet and Wet-Mesic Prairie	Mesic Prairie	Dry and Dry-Mesic Prairie	Alder Thicket and Shrub Carr	Aquatic Communities
Lampropeltis triangulum Eastern milk snake				X		X				X		X	X		
Thamnophis radix Eastern palins garter snake							X					X	X		
Thamnophis sirtalis Eastern garter snake			X				X	X			X				X
Storeria dekayi Brown snake						X				X		X			X
Storeria occipitomaculata Northern red-bellied snake	X			X						X					X
Sistrurus catenatus Eastern massasauga rattlesnake		X					X					X			X

Table B4 Fresh Water Mollusca of the Lake Poygan/Wolf River Study Area (Including the Fox River Drainage)

Name	Location Found
Fusconaia flava Wabash pig-toe	Fox River, Winnebago Co.
Fusconaia flava parvula *(probable) Little pig-toe	Lake Winnebago
Fusconaia undata Pig-toe	Fox River
Amblema costata Three-ridge	Fox River/C. Butte des Morts
Quadrula pustulosa prasira Flat pimple-back	Fox River
Tritogonia verrucosa *(probable) Buckhorn	Fox River
Pleurobema coccineum	Fox River
Elliptio dilatatus delicatus Delicate spike	Fox River
Elliptio dilatatus sterkii *(probable) Sterki's spike	Lake Winnebago/Butte des Morts
Lasmigona costata Fluted shell	Fox River/Lake Winnegago
Lasmigona complanta White-heel-splitter	Fox River

Table B4 Continued

Name	Location Found
Anodonta grandis Floater	Fox River
Anodonta grandis footiana Floater	Fox River
Anodonta kennicottii	Fox River
Anodonta marginata Paper-shell floater	Fox River
Utterbuckia imbecillis Paper pond shell	Fox River
Alasmidonta calceolus	Fox River/Wolf River
Alasmidonta calceolus danielsi	Fox Drainage
Strophitus rugosus pavonius	Fox Drainage
Strophitus rugosus winnebagoensis	Lake Butte des Morts/Lake Winnebago
Obliquaria reflexa Three-horned warty-back	Fox River
Obovaria olivaria Hickory-nut	Fox River
Actinonaias carinata Mucket	Fox River
Truncilla truncata Deer-toe	Fox River

Table B4 Continued

Name	Location Found
Truncilla truncata lacustris	Lake Winnebago
Leptodea fragillis Fragile paper shell	Fox River
Lepitodea fragilis lacustris Paper shell	Lake Winnebago/Fox River
Proptera alata Pink heel-splitter	Lake Winnebago/Butte des Morts
Proptera alata megaptera	Lake Winnebago/Butte des Morts
Carunculina parva Lilliput shell	Fox River
Ligumia recta	Lake Winnebago
Ligumia recta latissima Balck sand shell	Fox River
Lampsillis siliquoidea Fat mucket	Fox River
Lampsilis siliquoidea chadwicki	Lake Winnebago
Lampsilis ventricosa occidens	Fox River
Lampsilis ventricosa winnebagoensis	Lake Winnebago
Dysnomia triquetra	Fox River

Table B4 Continued

Name	Location Found
Sphaerium simile planatum	Lake Winnebago
Sphaerium lineatum sterki	Lake Winnebago
Sphaerium solidulum winnebagoense	Lake Winnebago
Sphaerium stamineum	Lake Winnebago
Sphaerium bakeri sterki	Fox River
Sphaerium striatinum	Lake Winnebago
Sphaerium striatinum corpulentum	Fox River
Sphaerium striatinum lilycashense	Fox River
Sphaerium ohioense sterki	Lake Winnebago
Sphaerium flavum foxense	Lake Butte des Morts
Sphaerium occidentale amphibium	Lake Butte des Morts
Musculium transversum	Lake Butte des Morts
Musculium jayense	Lake Butte des Morts
Musculium truncatus	Lake Butte des Morts
Musculium securis	Lake Butte des Morts
Pisdium virginicum	Lake Butte des Morts

Table B4 Continued

Name	Location Found
Pisidium compressum pellucidum	Lake Butte des Morts
Pisidium compressum limnicolumn	Fox River
Pisidium fallax	Lake Winnebago
Pisidium punctatum simplex	Lake Winnebago
Pisidium variabile	Lake Butte des Morts
Pisidium minusculum	Lake Butte des Morts
Pisidium glabellum	Lake Butte des Morts
Pisidium adamsi	Lake Butte des Morts
Pisidium sargenti sterki	Lake Butte des Morts
Pisidium noveboracense	Fox River
Pisidium seutellatum	Lake Butte des Morts
Pisidium scutellatum cristatum	Lake Butte des Morts
Pisidium walkeri sterki	Lake Butte des Morts
Pisidium superius	Fox River
Pisidium strengi sterki	Lake Butte des Morts
Pisidium politum decorum	Lake Butte des Morts
Pisidium splendidulum sterki	Lake Winnebago

Table B4 Continued

Name	Location Found
Pisidium griscolum sterki	Lake Winnebago
Pisidium milium	Lake Winnebago
Pisidium tenuissimum	Lake Winnebago
Pisidium pauperculum	Lake Butte des Morts
Pisidium vesiculara sterki	Lake Winnebago
Pisidium medianum	Lake Winnebago
Pisidium ferrugineum	Lake Winnebago
Pisidium subtruncatum	Lake Winnebago
Pisidium sphaericum sterki	Fox River

Table B5 Distribution of Fish Species in the Wolf/Fox Drainage

Name	Location Found
Acipenser fulvescens Lake Sturgeon	Lake Winnebago
Lepisosteus osseus Long-nosed gar	Lake Poygan
Hiodon tergisus Mooneye	Lake Winnebago/various locations
Ictiobus cyprinella Big-mouthed buffalo	Fox River
Ictiobus bubalus Small-mouth buffalo	Lower Fox River
Carpiodes cyprinus Quillback	Lake Winnebago
Catostomus commersonii Common sucker	Lake Poygan/Lake Winnebago
Erimyzon sucetta kennerlii Lake chub-sucker	Lake Poygan
Minytrema melanops Spotter sucker	Lake Poygan
Moxostoma rubreques Large red-horse	Upper Fox
Moxostoma m. macrolepidotum Northern red-horse	Upper Fox

Table B5 Continued

Name	Location Found
Hybopsis p. plumbens *Lake chub (probable)	Upper Fox
Semotilus a. atromaculatus *Creek chub (probable)	Lower Fox
Notropis roseus richardsonii Richardson shiner	Fox River
Notropis anogenus *Pug-nosed shiner (probable)	Fox River
Notropis blennius River shiner	Lake Winnebago
Notropis hudsonius seleni Northwestern spot-tailed shiner	Lake Poygan/Lake Winnebago
Notropis whipplii spilopterus Northern steel-colored shiner	Lake Poygan/Lake Winnebago
Notropis atherinoidea Lake shiner	Lake Winnebago
Notropis cornutus frontalis Northern common shiner	Lake Poygan
Notemigonus crysoleucas auratus *Western golden shiner (probable)	Upper Fox
Hybognathus hankinsoni *Brassy minnow (probable)	Upper Fox

Table B5 Continued

Name	Location Found
Hyborhynchus notatus Blunt-nosed minnow	Fox River/Lake Winnebago
Campostoma anomalum Stoneroller	Fox River/Lake Winnebago
Ictalurus p. punctatus Channel catfish	Fox River/Lake Poygan/Lake Winnebago
Villarius lacustris Northern catfish (probable)	Fox River
Ictalurus melas melas Northern black bullhead	Fox River
Ictalurus nebulosus nebulosus Brown bullhead	Fox River/Lake Winnebago
Ictalurus n. natalis Yellow bullhead	Fox River
Schilbeodes gyrinus *Tadpole stone-cat/madtom (probable)	Upper Fox River
Esox lucius Northern pike	Laek Poygan/Lake Winnebago
Esox masquinongy immaculatus Tiger muskellunge	Lower Fox River
Fundulus diaphamus menona Menona banded killfish	Fox River/Lake Winnebago

Table B5 Continued

Name	Location Found
Roccus chrysops White bass	Lake Winnebago
Perca flavescens Yellow perch	Lake Poygan/Lake Winnebago
Stizostedion vitreum Wall-eyed pike	Fox River/Lake Winnebago
Stizostedion canadense Sauger	Fox River/Lake Winnebago
Hadropterus phoxocephalus *Long-headed darter (probable)	Lake Winnebago
Percina caprodes semifasciata Northern log perch	Lake Poygan/Lake Winnebago
Cantonotus flabellaris lineolatus Striped fan-tailed darter	Lake Winnebago
Micropterus d. dolomicui Small-mouthed bass	Fox River/Lake Winnebago
Micropterus s. salmoides Large-mouthed bass	Fox River/Lake Winnebago
Lepomis m. macrochira Bluegill	Lake Poygan/Lake Winnebago
Lepomis megalotis peltastes Northern long-eared sunfish	Wolf River

Table B5 Continued

Name	Location Found
Lepomis gibbosus Pumpkinseed	Lake Poygan/Lake Winnebago
Ambloplites r. rupestris Rock bass	Lake Poygan/Lake Winnebago
Pomoxis nigromaculatus Black crappie	Lake Poygan/Lake Winnebago
Aplodinotus grunniens Sheepshead or Fresh water drum	Lake Poygan/Lake Winnebago
Cottus bairdii bairdii *Northern sculpin (probable)	Fox River
Eucalia inconstans *Brook stickleback (probable)	Lake Winnebago
Amia calva Bowfin	Lake Winnebago/Lake Poygan

comparisons between these two rivers can not be stated unequivocally, it is so noted (*).

APPENDIX C

APPENDIX C

IDENTIFIED ANIMAL SPECIES (BY ANATOMICAL ELEMENT) OF THE SAUER RESORT SITE

The following appendix has been compiled to allow for a more detailed inspection by archaeologists interested in the peculiarities of the Sauer Resort site assemblage. Examination of these species lists allows the reader a better appreciation of the magnitude and completeness of the faunal species represented. Also, by examining the kinds of elements identified here, zooarchaeologists working on assemblages of similar age, cultural affiliation and preservation, will develop a greater awareness of what elements may be identified from their particular assemblages.

The following descriptions are intended to be straightforward, with elements and positions being identified. In cases where elements were identified to a particular taxonomic level, but the position (left/right, or anatomical position, i.e. first molar) could not be ascertained, the term "indeterminate" follows the number of elements represented.

Two instances within the appendix are in need of further clarification. Because of the large number of turtle carapace fragments encountered in this assemblage, a workable method of positioning identified elements was needed in order to determine minimum number of individuals for each species represented. The initial step was to reassemble turtle carapaces of the species known to inhabit the waters surrounding the Sauer Resort site (see Appendix B). Upon completion of this, individual elements were illustrated in the following manner. Beginning with a dorsal perspective and using the neurals (nucal, suprapygal and pygal included) as a midline, the marginals and costals were numbered in succession with the side also being noted. For example, ML3 would be the third marginal in the succession and on the left side of the neural midline; likewise CR4 would be the fourth costal on the right side of the neural midline. The neurals were also numbered in a similar fashion, with the first neural (N1) being directly behind (posterior to) the nucal with each neural numbered in succession up to the suprapygal. By positioning each carapace element in this manner, it was possible to determine minimum number of individuals on carapace elements, without relying totally upon elements such as long bones, crania, vertebra and so forth. The second instance worthy of further explanation is the identification of freshwater drum otoliths or inner ear bones. Because an articulated drum skeleton was not available at the time of identification, it was not possible to determine left and right positions. However, through inspection it was possible to determine differences between elements, with categories "A" and "B" being designated for quantitative purposes.

Table C1 Identified Mammalian Elements from the Sauer Resort Site

Odocoileus virginianus

Mandible	14 left, 11 right
Astragalus	6 left, 6 right
Scapula	5 left, 2 right
Calcaneus	3 left, 3 right
Patella	1 right
Tibia	6 left, 3 right
Innominate	2 left, 6 right
Premaxillary	1 left,
Metacarpal	2 left, 1 right
Ribs	1 left, 2 right
Ulna	11 left, 2 right
Femur	1 left, 2 right
Radius	11 left, 6 right
Humerus	5 left, 6 right
Maxilla	1 right
Antler	46 fragments
Vertebra (Atlas)	1
Vertebra (Axis)	1
Vertebra (Cervical)	5
Vertebra (Thorasic)	5
Vertebra (Lumbar)	7
Phalanx (Prima)	37
Phalanx (Secunda)	22
Phalanx (Cloven bone)	21
Carpal (Naviculocuboid)	2 left, 3 right
Carpal (Sesamoid)	2 left, 4 right
Carpal (Magnum)	3 left, 2 right
Carpal (Cunneiform)	1 right
Carpal (Lateral malleolus)	1 right
Carpal (Lunate)	1 right
Carpal (Pisiform)	2 left
Carpal (Scaphoid)	1 right

Table C1 Continued

Carpals (Unciform)	1 left	
Tarsal (III)		1 right
First premolar (Lower)		2 right
First premolar (Upper)		1 right
Second premolar (Upper)		1 right
Second premolar (Lower)	1 left	
Fourth premolar (Lower)	1 left	
First molar (Upper)	1 left	
First molar (Lower)	3 left,	2 right
Third molar (Lower)	1 left	
Molars (No position)	7	
Temporal (Petrous portion)		2 right
Temporal (Zygomatic process)		1 right
Temporal (Bulla)		1 right
Squamosal (Zygomatic arch)		2 right
Basioccipital	1	
Cranium	13 fragments	
Misc. Elements	79 indeterminate	

Cervus canadensis

Mandible		2 right
Astragalus		2 right
Scapula		1 right
Humerus		1 right
Innominate	1 left	
Vertebra (Atlas)	1	
Vertebra (Cervical)	1	
Phalanx (Prima)	1	
Phalanx (Secunda)	4	
Carpal (Sesamoid)	1 left	
Carpal (Scaphoid)	1 indeterminate	

Table C1 Continued

Carpal (Pisiform)		1 right
Third incisor (Lower)		1 right
Third premolar (Upper)	1 left,	1 right
First molar (Lower)	1 left	
Second molar (Upper)		1 right
Molar (Root)	1 indeterminate	
cf. *Cervus canadensis*		
Maxillary	1 indeterminate	
Scapula	1 left,	1 right
Carpal (Pisiform)	1 indeterminate	
Molar	1 indeterminate	
Bison bison		
Scapula	2 left,	1 right
Vertebra (Lumbar)	1	
cf. *Bison bison*		
Scapula	1 left	
Ursus americanus		
Astragalus	1 left	
cf. *Ursus americanus*		
Mandible		1 right
Canis sp.		
Mandible		1 right
Innominate		1 right
Temporal (Bulla)		1 right
Tibia	1 left,	1 right
Calcaneus		1 right
Ulna		1 right
Squamosal	1 left	
Metapodial	1 indeterminate	
Second incisor (Upper)	1 left,	1 right

Table Cl Continued

Third incisor	1 left	
Fourth premolar (Lower)	2 left	
Second molar (Lower)	2 left,	1 right
Canine (Upper)		1 right
Canine (Lower)		1 right

cf. *Canis* ps.

Fibula	1 left	
Metapodial	1 indeterminate	
Vertebrate (Thorasic)	1	
Vertebra (Lumbar)	1	
Canine (Lower)	2 left	

Procyon lotor

Mandible		1 right
Maxillary	2 left	
Calcaneus	1 left	
Radius	1 left	
Ulna	2 left,	1 right
Femur	3 left,	1 right
Fibula	2 left,	1 right
Humerus	3 left,	1 right
Astragalus		1 right
Tibia	2 left	
Third incisor (Lower)		1 right
Second premolar (Upper)		1 right
Third premolar (Upper)	1 left	
Second molar (Lower)	2 left,	1 right
Cranium	19 fragments	

cf. *Procyon lotor*

Canine (Upper)	1 left	
Canine (Lower)	1 left	
Second molar (Lower)		1 right

Table Cl Continued

Castor canadensis

Cranium (Zygomatic arch)	1 left,	1 right
Humerus	1 left,	1 right
Clavicle	1 left	
Calcaneos	1 left	
Scapula		1 right
Ulna	1 left	
Astragalus		1 right
Patella	1 left	
Incisor (Lower)		5 right
Incisor	6 indeterminate	
First molar (Upper)		1 right

Marmota monax

Mandible	1 left	
Tibia	1 left	
Scapula		1 right
Calcaneos	1 left	
Astragalus	1 left	
Femur	1 left,	2 right
Intrusive (Individual)	50 elements identified	

Citellus tridecemlineatus

Femur	2 left,	1 right

cf. *Citellus tridecemlineatus*

Innominate		1 right
Femur	2 left,	1 right
Ulna	1 left	

Tamias striatus

Mandible	3 left,	2 right
Cranium	1	
Innominate	1 indeterminate	
Humerus	1 left,	1 right
Ulna	1 left,	1 right

Sciurus sp.

Mandible	1 left	

Table C1 Continued

Ondatra zibethicus

Mandible	4 left,	1 right
Cranium	1	
Maxillary	3 left	
Innominate	4 left	
Astragalus	1 left	
Scapula	1 left	
Tibia	2 left,	3 right
Radius	1 left,	1 right
Ulna	2 left,	2 right
Calcaneus	2 left,	1 right
Femur	4 left,	2 right
Humerus	2 left,	2 right
Metapodial	1 left	
Vertebra	7 indeterminate	
Incisor (Lower)	1 indeterminate	
First molar (Upper)	1 left,	1 right
Molar (indetermined)	2 fragments	

Microtus pennsylvanicus

Mandible	5 left,	6 right
Maxillary/cranium	4	

Microtus ochrogaster

Mandible		2 right

Microtus sp.

Mandible	6 left,	5 right
Cranium	6	

Soricidae

Mandible		1 right

Taxidea taxus

Innominate		1 right
Radius	1 left	

Mustela vison

Mandible	1 left,	2 right
Maxillary		1 right
Radius	1 left	

Table C1 Continued

cf. *Mustela vison*		
Canine (Lower)		1 right
Martes americana		
Tibia		2 right
Lutra canadensis		
Ulna		1 right
Mephitis mephitis		
Radius		1 right
Sus scrofa		
Humerus	1 left	
Homo sapien		
Mandible	1 left	
Maxillary	1 left,	1 right
Mastoid process/ Auditory meatus	1 left	
Premolar (indetermined)	1	
Second molar (Upper)		1 right
Molar (indetermined)	1	

Table C2 Identified Avain Elements from the Sauer Resort Site

Aythya marila		
Coracoid	3 left,	1 right
Aythya valisineria		
Sternum	3	
Cranium	1	
Humerus	1 left	
Coracoid	1 left,	2 right
Aythya affinis		
Sternum	1	
Femur		1 right
Coracoid	5 left,	3 right
cf. *Aythya affinis*		
Sternum	1	
Coracoid		1 right
Aythya collaris		
Sternum	1	
Coracoid		2 right
Aythya americana		
Sternum	1	
Coracoid	1 left,	1 right
Aythya sp.		
Sternum	21	
Coracoid	14 left,	12 right
Tibiotarsus		1 right
Humerus	1 left,	4 right
Anas platyrhynchos		
Sternum	1	
Cranium	1	
Humerus		1 right
Coracoid		1 right
Femur		1 right
Anas acuta		
Sternum	1	

Table C2 Continued

Anas discors or *crecca*		
Cranium	1	
Coracoid	1 left,	1 right
Femur	1 left	
Anas sp.		
Sternum	1	
Coracoid	1 left	
Aix sponsa		
Coracoid		1 right
Mergus merganser		
Sternum	1	
Mareca americana		
Cranium	1	
cf. *Mareca americana*		
Humerus	1 left	
Oxyura jamaicensis		
Coracoid	2 left,	1 right
Bucephala clangula		
Coracoid	2 left	
cf. *Bucephala clangula*		
Sternum	1	
Coracoid	1 left	
Duck spp.		
Cranium	9	
Pelvis	3 left,	10 right
Femur	1 left,	1 right
Radius	40 left,	34 right
Scapula	41 left,	25 right
Humerus	18 left,	15 right
Carpometacarpus	44 left,	58 right
Coracoid	32 left,	22 right
Ulna	24 left,	32 right
First phalanx	6 left,	8 right

Table C2 Continued

Sternum	49	
Tibiotarsus	17 left,	21 right
Tarsometatarsus	11 left,	8 right
Trachea	4	
Furculum	42	
Misc. Element	198 indeterminate	
Branta canadensis		
Cranium	1	
Humerus	2 left	
Tarsometatarsus		1 right
First phalanx	1 left,	2 right
Chen caerulescens		
Furculum	1	
Fulica americana		
Humerus	2 left,	1 right
Scapula		3 right
Coracoid	1 left	
Porzana carolina		
Carpometacarpus	1 left	
Podilymbus podiceps		
Coracoid	2 left,	1 right
Scapula	1 left	
Ulna	1 left,	1 right
Femur	1 left	
cf. *Podilymbus podiceps*		
Cranium	1	
Carpometacarpus	1 left	
Nycticorax nycticorax or *Botaurus lentiginosus*		
Tibiotarsus		1 right
Tarsometatarsus	1 left	
Ectopistes migratorius		
Tibiotarsus	2 left	

Table C2 Continued

Buteo jamaicensis		
Coracoid	1 left,	1 right
Buteo sp.		
Scapula	1 left,	1 right
Phalanges (Distal)	1	
Tarsometatarsus		1 right
Accipiter sp.		
Tarsometatarsus		1 right
Colaptes auratus		
Humerus	1 left	
Ulna		1 right
Passeriformes		
Humerus	1 left,	1 right
Ulna	2 left	
Tibiotarsus		1 right

Table C3 Identified Amphibian/Reptilian Elements from the Sauer Resort Site

Chrysemys picta

Femur		1 left	
Illium		1 left,	1 right
Radius			1 right
Xiphiplastron			1 right
Entoplastron		1 indeterminate	
Hyoplastron		1 left	
Hypoplastron		2 left	
Epiplastron		1 left,	1 right
Carapace			
Includes:			
Marginals	MR4	1	
	ML9	1	
	ML18	1	
	MR8	2	
	MR7	3	
	ML3	1	
	MR2	1	
	MR11	1	
	MR3	4	
	ML1	3	
	MR6	1	
	ML8	3	
	MR1	2	
	ML11	1	
	ML7	1	
	ML2	3	
	ML4	1	
	ML10	1	
Costals	CR7	3	
	CL7	1	
	CL1	1	
	CR4	6	
	CR6	2	
	CR1	2	
	CL6	1	
	CR4	1	
	CL14	1	
	CR3	2	
	CL4	3	
Neurals			
Nucal		4	
Misc. elements		21 indeterminate	

Chelydra serpentina

Vertebra (indeterminate)	3	
Illium		1 right
Scapula	2 left	

Table C3 Continued

Tibia		1 left,	1 right
Carapace			
Includes:			
Marginals	MR2	1	
	ML7	1	
	ML10	2	
	MR10	2	
	MR11	2	
	MR4	1	
Costals	CR8	1	
	CR7	1	
	CL6	1	
	CR6	1	
Neurals			
Nucal		1	
Pygal		1	
Misc. carpace Fragments		38 indeterminate	

cf. *Chelydra serpentina*

Fibula			1 right
Carapace			
Includes:			
Neurals	N8	1	

Emydoidea blandingi

Vertebra (indetermined)		1	
Femur		1 left	
Epiplastron, Entoplastron, Hyoplastron (Articulated)		1	
Carapace			
Includes:			
Marginals	ML5	1	
	ML3	1	
	MR10	1	
	ML10	1	
	MR3	1	
	MR2	1	
	MR8	2	
	ML11	1	
	MR6	1	
	MR1	1	
	MR9	1	
	MR5	1	
Costals	CL4	1	
	CR7	1	
	CL6	1	
	CR1	1	
	CR6	2	
	CR5	1	

Table C3 Continued

Neurals	N8	1
	N5	1
	N1	1
cf. *Emydoidea blandingi*		
Carapace		
Includes:		
Marginals		2 indeterminate
Costals	CR1	1
Terrapene carolina		
Carapace		
Includes:		
Marginal	CL3	1
Trionyx spinifer		
Carapace		
Includes:		
Costal		1 indeterminate
cf. *Clemmys insculpta*		
Carapace		
Includes:		
Marginal	ML11	1
Graptemys geographica		
Vertebra (Indeterminate)		1
Carapace		
Includes:		
Marginals	ML11	1
	MR11	1
Costals	CL1	1
	CR7	1
cf. *Graptemys geographica*		
Carapace		
Includes:		
Marginals	ML3	1
Neurals	N4	1
Turtle spp.		
Misc. Elements		116 indeterminate
Sistrurus catenatus		
Vertebra (indeterminate)		2

Table C3 Continued

Elaphe vulpina

Vertebra (indeterminate)	1	

Rana sp.

Humerus	5 left,	11 right
Illium	1 left,	1 right
Vertebra (indeterminate)	1	
Tibiofibula		1 right
Radioulna	1 left,	2 right
Misc. Elements (indeterminate)	31	

Bufo sp.

Astragalus	1 left	
Calcaneus		1 right
Femur	2 left	
Illium	4 left,	6 right
Humerus	2 left,	1 right
Podials and Carpals	16 indeterminate	
Tarsal (Proximal)		1 right

Rana/*Bufo* spp.

Misc. Elements (indeterminate)	34	

Table C4 Identified Fish (Osteichthyes) Elements from the Sauer Resort Site

Stizostedion sp.

Dentary	85 left, 85 right
Premaxillary	36 left, 38 right
Palatine	27 left, 25 right
Quadrate	45 left, 42 right
Preoperculum	37 left, 32 right
Supramaxillary	6 left, 3 right
Maxillary	47 left, 57 right
Post-temporal	5 left, 6 right
Interoperculum	9 left, 9 right
Frontal	12 left, 8 right
Articular	13 left, 35 right
Suboperculum	6 left, 5 right
Cervatahyal	54 left, 68 right
Epihyal	13 left, 21 right
Cleithrum	16 left, 20 right
Supracleithrum	2 right
Hyomandibular	31 left, 27 right
Parasphenois	33
Vomer	3
Misc. Elements	24 indeterminate

Perca flavescens

Lacrimal	1 left, 3 right
Frontal	1 right
Preoperculum	12 left, 12 right
Urohyal	1 left, 1 right
Endopterygoid	1 right
Suboperculum	1 left, 1 right
Cleithrum	7 left, 9 right
Maxillary	1 left, 1 right
Operculum	23 left, 18 right
Hyomandibular	1 right
Dentary	2 left
Quadrate	1 left, 1 right

Moxostoma sp.

Maxillary	13 left, 13 right
Hyomandibular	34 left, 17 right
Operculum	18 left, 8 right
Weberian process	1
Suboperculum	4 left, 5 right
Cleithrum	23 left, 26 right
Pharygneal	14 left, 10 right
Dentary	1 right
Parasphenoid	14
Basipterygium	3 left, 3 right
Misc. elements	3 indeterminate

Table C4 Continued

Hypentalium nigricans		
Quadrate		1 right
Ceratahyal	1 indeterminate	
Ictiobus sp.		
Pharygneal		1 right
Maxillary		1 right
Parasphenoid	3	
Catastomus commersonii		
Maxillary		1 right
Basipterygium	1 left	
Catostomidae		
Operculum	1 left	
Pharygneal	2 left,	2 right
Lepisteus osseus		
Endopterygoid	1 left	
Dentary	3 left	
Accipenser fulvescens		
Dermal plates	66 fragments	
Aplodinotus grunniens		
Preoperculum	1 left	
Premaxillary	4 left,	7 right
Otolith (Inner ear)	6 "A",	4 "B"
Pharygneal (Upper)		2 right
Pharygneal (Lower)	2 left,	4 right
Operculum	7 left,	4 right
Quadrate		1 right
Epihyal		1 right
Ceratahyal		2 right
Maxillary	1 left,	2 right
Dentary	1 left,	2 right
Articular		1 right
Ictalurus melas		
Coracoid	3 left,	8 right
Operculum	2 left,	7 right
Hyomandibular	1 left,	1 right
Supraethmoid	1	
Dentary	1 left	

Table C4 Continued

Ictalurus natalis or *nebulosus*		
Coracoid	4 left,	9 right
Post-temporal	1 left	
Hyomandibular	4 left,	7 right
Supraethmoid	6	
Operculum	14 left,	5 right
Ictalurus punctatus		
Dentary	17 left,	9 right
Premaxillary	6 left	
Operculum	31 left,	30 right
Quadrate	16 left,	10 right
Epihyal	1 left,	2 right
Ceratahyal	4 left,	4 right
Articular	6 left,	10 right
Palatine	5 left,	4 right
Pectoral spines	9 left,	8 right
Coracoid	9 left,	6 right
Cleithrum	7 left,	5 right
Maxillary	1 left,	4 right
Post-temporal	2 left,	1 right
Frontal	6 left,	1 right
Supraethmoid	8	
Parasphenoid	3	
Hyomandibular	15 left,	10 right
Pylodictis olivaris		
Ceratahyal		1 right
Ictalurus sp.		
Dentary	113 left,	113 right
Premaxillary	7 left,	1 right
Quadrate	5 left,	17 right
Epihyal	4 left,	1 right
Articular		1 right
Operculum	2 left	
Ceratahyal	7 left,	13 right
Misc. Elements	1 indeterminate	
Ictalurus sp.		
Premaxillary		1 right
Ceratahyal	2 left	
Articular		1 right
Dentary	3 left,	2 right
Ictalurus sp.		
Dentary	5 left,	9 right
Premaxillary	2 left,	3 right

Table C4 Continued

Quadrate	3 left,	9 right
Operculum	6 left,	8 right
Pectoral spine	119 left,	95 right
Articular	55 left,	36 right
Epihyal	12 left,	9 right
Ceratahyal	5 left,	4 right
Palatine	2 left,	1 right
Cleithrum	121 left,	109 right
Coracoid	13 left,	24 right
Hyomandibular	16 left,	24 right
Post-temporal	7 left,	7 right
Preoperculum	1 left,	2 right
Urohyal	1 indeterminate	
Supraethmoid	3	
Frontal		1 right
Parasphenoie	12	
Weberian process	10	
Misc. Elements	24 indeterminate	
Ambloplites rupestris		
Supracleithrum	1 left	
Micropterus sp.		
Pharygneal	2 left,	1 right
Quadrate	11 left,	9 right
Epihyal	3 left,	4 right
Articular	3 left,	7 right
Suboperculum		1 right
Supracleithrum	1 left,	3 right
Dentary	9 left,	21 right
Premaxillary	14 left,	7 right
Operculum	1 left,	6 right
Scapula	1 left	
Maxillary	13 left,	2 right
Frontal	1 left,	2 right
Cleithrum	12 left,	14 right
Parasphenoid	6	
Interoperculum	1 left	
Suboperculum	3 left,	2 right
Palatine	2 left,	1 right
Preoperculum	6 left,	9 right
Hyomandibular	3 left,	4 right
Post-temporal	4 left,	5 right
Misc. Elements	5 indeterminate	
Esox lucius		
Dentary	5 left,	6 right
Premaxillary	8 left,	6 right
Quadrate	1 left,	1 right
Ceratahyal	1 left,	3 right
Supramaxillary		2 right

Table C4 Continued

Articular	13 left, 16 right
Hyomandibular	2 left, 2 right
Parasphenoid	2
Cleithrum	2 left, 1 right
Frontal	2 right
Misc. Elements	3 indeterminate

Esox sp.

Operculum	1 left
Quadrate	12 left, 10 right
Ceratahyal	1 left, 2 right
Dentary	8 left, 7 right
Premaxillary	11 left, 5 right
Supramaxillary	1 left, 3 right
Parasphenoid	3
Hyomandibular	4 left, 8 right
Cleithrum	19 left, 13 right
Misc. Elements	6 indeterminate

Roccus chrysops

Dentary	10 left, 6 right
Quadrate	15 left, 10 right
Maxillary	1 left
Premaxillary	5 left, 2 right
Ceratahyal	1 right
Articular	4 left, 5 right
Cleithrum	6 left, 3 right
Hyomandibular	1 left
Parasphenoid	1
Preoperculum	1 left, 4 right

Pomoxis sp.

Ceratahyal	9 left, 8 right
Quadrate	1 left, 1 right
Hyomandibular	1 left, 4 right
Post-temporal	1 left
Dentary	3 left, 1 right
Preoperculum	5 left, 5 right
Maxillary	3 left, 5 right
Cleithrum	15 left, 17 right
Suboperculum	3 left, 2 right
Operculum	2 left, 2 right
Misc. Elements	2 indeterminate

Lepomis sp.

Urohyal	2 indeterminate
Supracleithrum	3 right
Parasphenoid	16
Dentary	16 right
Premaxillary	15 left

Table C4 Continued

Quadrate	1 left	
Operculum	26 left,	19 right
Ceratahyal	2 left	
Hyomandibular	5 left,	1 right
Interoperculum	4 left,	5 right
Pharygneal (Upper)		1 right
Pharygneal (Lower)		1 right
Articular	1 left	
Preoperculum	43 left,	33 right
Cleithrum	17 left,	22 right

Centrarchidae

Qaudrate	1 left,	1 right
Operculum	3 left,	5 right
Articular	1 left,	4 right
Interoperculum	2 left,	2 right
Post-temporal	1 indeterminate	
Suboperculum	1 indeterminate	
Preoperculum		1 right
Parasphenoid	1	
Basipterygium	1 left	
Misc. Elements	23 indeterminate	

Amia calva

Ceratahyal		1 right
Operculum	7 left,	3 right
Ectopterygoid	5 left,	2 right
Prevomer	2 left,	1 right
Premaxillary	1 left,	1 right
Frontal	3 left,	1 right
Articular	1 left	
Maxillary		1 right
Dentary	7 left,	4 right
Brachiostegal		1 right
Palatine	1 left	
Supracleithrum	1 left,	1 right
Post-temporal	4 left,	4 right
Hyomandibular	1 left,	2 right
Cleithrum	1 left,	6 right
Oular	6 left	
Suboperculum	4 left,	2 right
Parasphenoid	2	
Misc. Elements	92 indeterminate	

Hiodon sp.

Dentary	1 left

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