Vol. 2 Ch. 3 Ohio Hopewell Settlements on Brown's Bottom

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Chapter 3

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The Brown's Bottom project is a collaborative effort between SUNY Geneseo, Bloomsburg University, and Ohio Valley Archaeology, Inc. The collaboration was formed at the 2004 Midwest Archaeological Conference meetings in Columbus, Ohio after hearing Bret Ruby, Doug Charles, and Chris Carr's presentation about regional Hopewell settlement patterns (which subsequently became Ruby et al. 2005). We decided that a multi-stage research design integrating geophysical prospecting with strategic excavations and using the labor of the combined Geneseo and Bloomsburg field schools would allow us to investigate the open questions and issues exposed by Ruby and his colleagues about Ohio Hopewell settlement and subsistence patterns in the central Scioto Valley.

The key moment came that winter, when an initially reluctant Robert (Bob) Harness, was convinced to let us work on his archaeologically famous Harness Farm, located about 11 km south of Chillicothe, Ohio, along old State Route 35. This 1,700+ acre farm is home to the Liberty Earthworks (Figure 1), surveyed by Squier and Davis (1848). The farm has hosted a number of important archaeological investigations, including excavations at Edwin Harness Mound (Greber 1983; Mills 1907), Russell Brown Mounds (Seeman and Soday 1980), Harness 28 (Seeman and Dancey 2000), and Ceplus (Seeman 1992). Prufer's NSF sponsored Scioto Survey covered large portions of the farm (Prufer 1967), and Bob's well

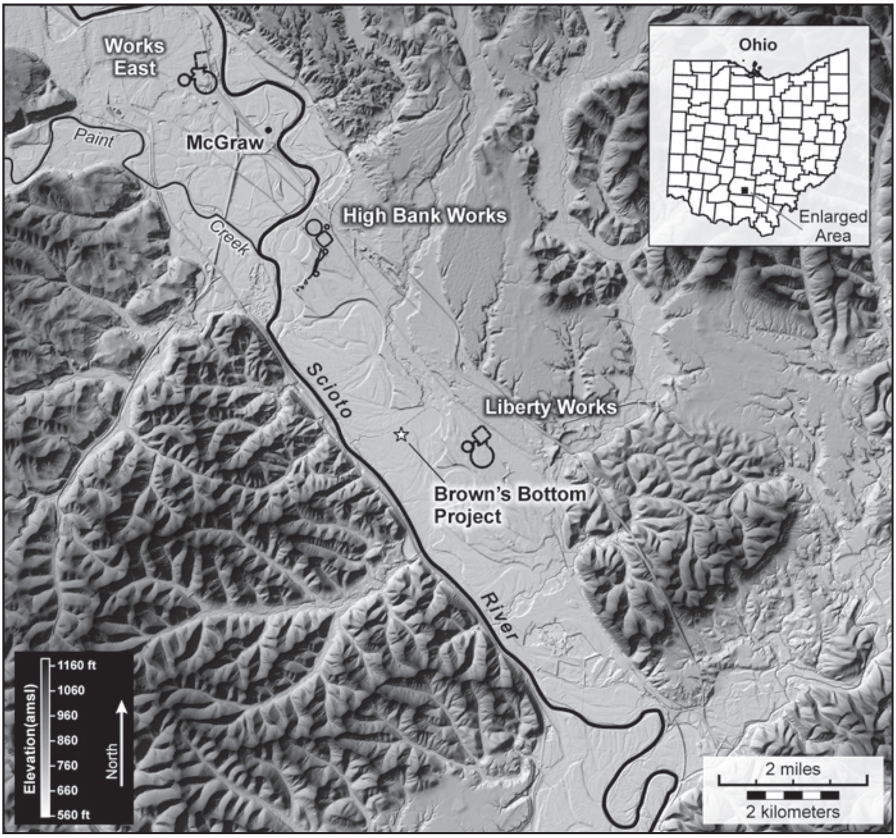

Figure 1. Topographic location of Brown's Bottom Project in Ross County, Ohio; also shows locations of McGraw site and nearby Ohio Hopewell earthworks.

provenienced artifact collection spawned archaeological research, too (Converse 1994; Coughlin and Seeman 1997; Greber et al. 1981).

Prufer's inclusion of the Harness Farm in his Scioto Survey was critical to our interest, as this project included survey and test excavations on Brown's Bottom. Prufer named it Brown's Bottom because, when he was given access by Bob Harness, Russell Brown was then the tenant farmer. Bob Harness, incidentally, never liked this name and often quipped, "Brown was the name of the farmer, not the land owner"; unfortunately we could not rectify this issue to Bob's satisfaction.

Prufer's team conducted surface survey on Brown's Bottom in the spring of 1963, followed by excavations that summer in the easternmost of three identified clusters containing possible Hopewell domestic debris. His crew, supervised by

Harvard graduate student Elizabeth E. Baldwin (Garland), who went on to have a distinguished career at Western Michigan University, began the excavation of four 10 x 10 ft squares on July 16, 1963. They soon ceased the operations because Prufer "was deeply disappointed by the shallowness of the deposits" and because of Alva McGraw's tempting claim about a buried Hopewell midden on his farm eight kilometers to the north (Prufer 1963). The team shifted most of their efforts to the McGraw site (Prufer 1965) on July 30, filling in the last partially completed unit at Brown's Bottom, labeled Unit D, on August 23. John Blank (1965) wrote up a brief site report of the 1963 Brown's Bottom excavation as a training exercise (Prufer 1996:410), although Prufer (1964) mentioned it briefly the prior year.

Thus, we knew going in that a series of possible Hopewell settlements existed on Brown's Bottom which had received minimal attention. Since our research strategy included geophysical prospecting, we were interested in testing Prufer's assumption that all of the features at the site were either plowed away or destroyed by floods. In retrospect, he was thankfully quite mistaken. Our first problem was relocating where Prufer's team had worked, as there was no permanent datum. With a small crew of volunteers, Burks conducted a transect surface survey, using 5 m spacing in April 2005, knowing only that the clusters were located somewhere in the 50-acre section of Brown's Bottom which Bob Harness labeled "Field T." A Trimble GEO XT GPS was used to piece plot all encountered artifacts, resulting in approximately 3,000 artifacts being mapped, with fire-cracked rock (FCR) by far the most abundant category. On the eastern edge of the field, paralleling a slight topographic rise, there was a noticeable artifact concentration including three Hopewell bladelets, a Middle Woodland projectile point, several small grit-tempered, cordmarked sherds, a celt fragment, a fragment of worked slate, and abundant FCR (Figure 2). This cluster became Brown's Bottom #1 (BB#1), using the "#" sign as part of the name to clarify that this refers to our work. The site occupies a slight rise on the active floodplain, south of Dry Run—today an intermittent stream—about 1.7 km northwest of the Liberty Earthworks and 1.3 km east of the Scioto River (Lat/Long degree decimal: N39.259446, W82.896466).

Burks conducted a magnetic gradiometer survey measuring 40 x 60 m at BB#1 in late April 2005, with a southwest grid corner coordinate designated 2000E /2000N. The magnetic gradiometer survey ultimately expanded to an area of just under 40,000 m^2 over the course of the project (Figure 3). Forty-four potential cultural anomalies were identified in the initial magnetic data. These were groundtruthed through coring using a 2.5 cm diameter Oakfield soil probe, with 28 out of

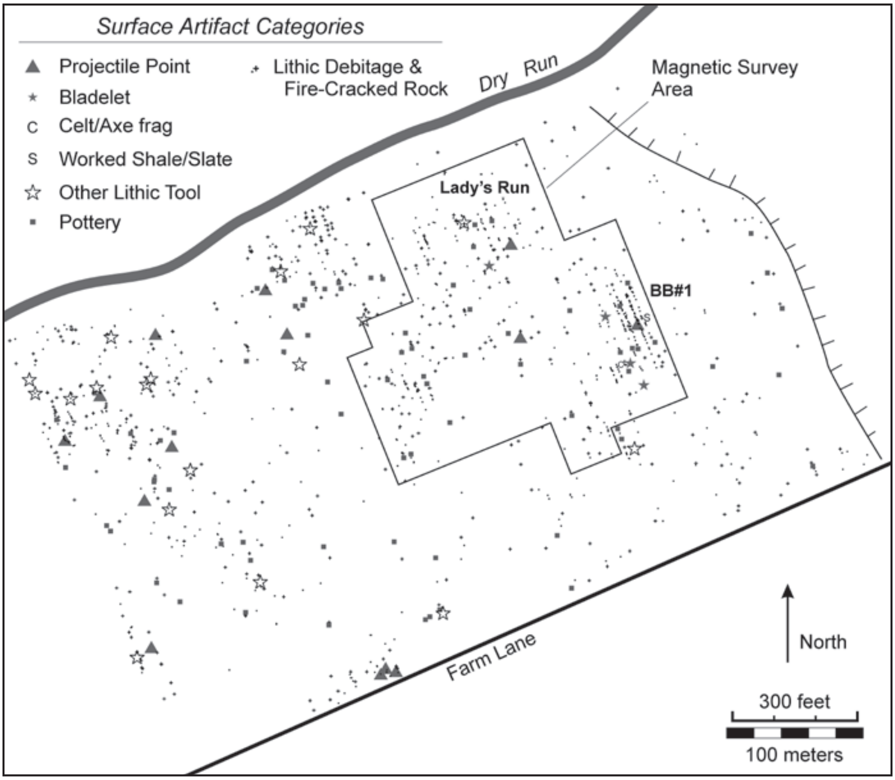

Figure 2. Distribution of artifacts recovered during surface survey, April 2005.

44 yielding evidence of being possible features. In mid-May 2005, joint Geneseo and Bloomsburg archaeology field schools tested a purposive sample of six of these possible features and opened a trench looking for evidence of structures (see Pacheco et al. 2005 for discussion of the sampling strategy). That was the first of our six field seasons on Brown's Bottom, with 2006 also at BB#1 (33RO1104). The 2007–2008 and 2010–2011 field seasons focused on Lady's Run (33RO1105), which is a companion cluster to BB#1 located about 100 m to the northwest, as measured from the BB#1 structure to Lady's Run Structure 1. Field seasons averaged thirty students working for twenty days each. All field work was supervised by Pacheco and Wymer, supported by an average of four field assistants.

Preliminary reports for BB#1 and Lady's Run can be found on the Ohio Archaeological Council website (Pacheco et al. 2005, 2009a, 2009b). Additional details about BB#1 have been published by Burton (2006) in *American Archaeol-*

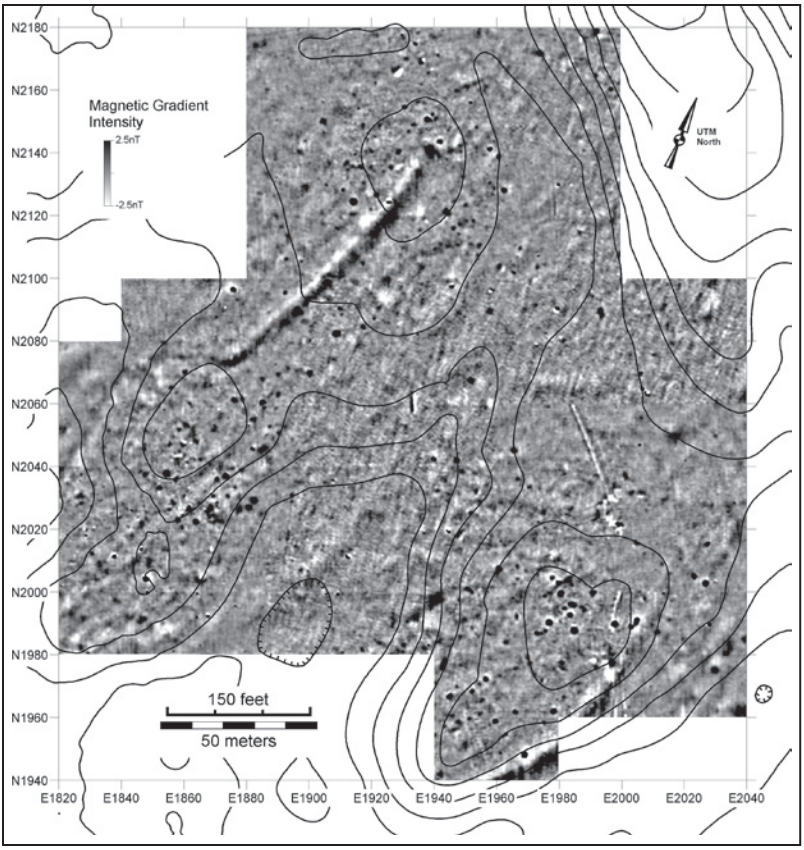

Figure 3. All raw magnetometry data; scale in nanoteslas (nT). Contour interval = 10 cm.

ogy, by Carr (2008:105–115) in his synthesis of Scioto Hopewell settlement archaeology, and by Dalan (2008:20–21) in her review of the role of magnetic susceptibility methods in North American archaeology. Directed studies supervised by Pacheco at Geneseo produced an analysis of the Ohio Hopewell bladelet assemblage from BB#1 (Snyder et al. 2008), and a structural engineering analysis of the three complete structures excavated during the project (Kanter et al. 2015). The latter paper also includes a description of the structure's interior spaces. Wymer's chapter in this volume documents the paleoethnobotanical material we recovered, while chapters by Nolan et al. and Hill et al. in this volume include new pXRF (portable X-Ray Fluorescence) and other sourcing data on the lithic and ceramic assemblages. Separate publications are planned for the geophysics, and analyses of the cut mica, domesticated canids, and buried refuse deposits.

The purpose of this report is to summarize the results of the project as a whole, pulling together key details and overview maps, with emphasis on feature data, culturally important aspects of the assemblages, and chronology. An analysis of evidence for seasonality and deer hunting patterns is then presented as support for the conclusion that these Ohio Hopewell settlements represent year round domestic residential bases which utilized a logistical mobility strategy to move resources to extended family households (Kelly 1991; Pacheco and Dancey 2006).

STRATEGIES AND METHODS

A multi-stage research design was utilized for the Brown's Bottom project beginning with the surface survey that identified artifact clusters within Harness Field T. The surface survey was followed by geophysical prospecting, anomaly coring, excavation of features using the quarter method to provide two continuous profiles for mapping and soil sampling, and trenching and block excavations to expose evidence of possible structures.

Critical to our strategy that first season (Pacheco et al. 2005) was our interest in recovering faunal remains, with the goal of providing seasonality evidence to complement existing ethnobotanical data (Wymer 1996, 1997). The anomalies purposively chosen for excavation turned out to be pit features with abundant faunal remains. These will be the focus of the discussion on seasonality and deer hunting patterns below. A 1 x 20 m trench was placed strategically to cut across an area devoid of anomalies within the initial 40 x 60 m magnetometry block to look for evidence of structures. Two rock-filled post holes were discovered in this trench. Following the line of these post holes with block excavation revealed the structure at BB#1.

In March 2006, additional magnetometry was added. Anomalies identified during this survey were the focus of the 2006 field season. This pattern of doing magnetometry survey in March over spring break continued through 2009, eventually leading to the coverage shown in Figure 3. The 2006 field season focused on obtaining data from a stratified random sample of anomalies/pit features based on the magnetic amplitude of anomalies, as well as excavation of five additional 1 x 20 m trenches to look for other structures. The interior space of the structure was also excavated. Additional details about the strategies for choosing and excavating these anomalies and trenches are presented in Pacheco et al. (2009a).

We shifted our attention to what became known as Lady's Run in 2007. Our overall plan was to sample the magnetic anomalies in this cluster using the same approach we had used at BB#1 in 2006, focusing on obtaining a stratified random sample based on anomaly amplitude. Prior to beginning feature excavation, we excavated 1 x 1 m units in the southwest corner of every 20 m grid block using a systematic aligned sampling technique for the purpose of training students in excavation and screening techniques, and to get a sense of density of the artifacts in the plow zone. While this strategy was designed to avoid anomalies identified in the magnetic survey, one of the units discovered F421, which turned out to be buried, sub-plow zone secondary refuse, located in a swale-like depression, with depths extending down to 60 cm below the surface.

During excavation of one of the anomalies chosen in the stratified random sample, we discovered four rock-filled post holes, which turned out to be the northern corner of Lady's Run Structure 1. In the 2008 field season, we focused on revealing the complete plan and interior space of Structure 1 and obtaining a robust sample of the buried secondary refuse in F421. Additional details about the strategies and approaches used in these two field seasons can be found in Pacheco et al. (2009b).

In the 2010 field season, our goal was to expand and complete the stratified random sample of magnetic anomalies, and then pivot to some purposive excavation. During excavation of F417, which was chosen in the expanded stratified random sample, we discovered three rock-filled post holes, which turned out to be the eastern corner of Lady's Run Structure 2. The rest of the 2010 field season was spent using block excavation to uncover the post pattern of this structure.

In the 2011 field season, we focused on completing the excavation of the interior of Structure 2 and trenching in the area to the west of this structure. We also took the opportunity to explore the long linear anomaly curving southwest of F421 in the magnetic gradient data (see Figure 3). We determined that this linear anomaly represents a buried paleochannel, with F421 sitting at its northeast end. Additional 1 x 1 m and 2 x 2 m units were excavated into the channel area, resulting in discrete stratigraphic and artifact samples along the channel's length to bolster and compare to the robust sample from F421.

A transect sample of handheld post hole digger units, which are 20 cm in diameter, was also used to investigate artifact density along the length of the channel (Bender 2011). The post hole digger transect was initiated three meters south of F421 and continued southwest for a distance of 85 m. This resulted in 17 post hole digger units spaced every five meters. We then placed perpendicular radial post hole digger units at a distance of 2.5 m to establish the lateral boundaries of the paleochannel. For each of the 17 original post hole digger units, we dug two radial units to the southeast and two radial units to the northwest, with the exception of Post hole #1, which had three radial units to the southeast.

Towards the end of the 2010 field season, relationships with Bob's widow began to deteriorate. Despite the fact that he had left us a 25-year scientific easement in his will, we decided to make the 2011 season our last.

RESULTS

FEATURES AND INTERNAL SITE ORGANIZATION

This section presents the excavated Hopewell features, as determined by the presence of diagnostic artifacts, and the internal organization of space at each site. Undetermined and non-Hopewell features will be given minimal attention. Two Late Woodland features were excavated at BB#1, from what appears to be a spatially discrete component. At least six Late Woodland and four Early Woodland features were excavated at Lady's Run, but unlike BB#1, these components spatially overlap the Hopewell features at the site. BB#1 will be presented first, followed by Lady's Run.

A total of twenty-one Hopewell pit features were excavated on the exterior of the BB#1 structure (Table 1). Three types of exterior pit features were identified in the sample: basins, earth ovens, and graves.

Basins had lower amplitude magnetic signatures, no evidence for internal burning, sloping walls with conical bottoms, little to no FCR, and generally much lower densities of cultural materials. An exception to this pattern is F196, an elliptical, basin-shaped pit located 25 m southwest of the structure (Figure 4). The highest number and density of bladelets of any pit feature, a reworked, end-notched projectile point, the base of a tetrapodal ceramic pot, and a small copper awl were recovered from F196. This grouping may represent secondary refuse from a tool kit.

Basins located immediately adjacent to the structure, such as F12, F18, and F19, may have served as storage pits based on their proximity to the structure and the lack of refuse in their fill. The bottom of F12 was hard to discern because of tree root disturbance. This feature was only partially excavated, but the general impression is that it was a lot larger than what we sampled. Two other large anomalies, located outside the southwest and southeast walls respectively, were left unexcavated. Perusal of the magnetic anomaly map (Figure 3 and Pacheco et al. 2009a:Figure 2) suggests several additional unexcavated basins are located southwest of the structure.

A total of eight earth ovens were excavated at BB#1, and an additional eight to twelve earth ovens were left unexcavated, especially in the arc of ovens located

Table 1. Data from Excavated Brown's Bottom #1 Pit Features.

BB#1 Exterior Pits											
Feature #	Class	Length cm	Width cm	Depth cmbpz	Feature Volume screened m^3	FCR kg	Bone g	Shell g	Sherds	Sherds g	Bladelets
12	Basin (1/2)	90	76	42	0.173	7.95	1.8	147.4	106	284	6
18	Basin (1/4)	73	70	40	0.072	0	7.9	0	26	70	0
29	Basin	135	92	55	0.349	1.9	87.8	196.9	88	171	4
35	Earth Oven	145	137	54	0.561	85.15	728.3	1197.8	425	1277	15
38	Earth Oven	160	158	90	1.608	89.45	2968.3	6211.7	1120	4298	14
39	Earth Oven	142	120	52	0.626	54.25	402.9	454.9	172	600	15
184	Basin (1/2)	132	82	50	0.191	0.25	0	1.7	2	3	1
196	Basin	92	87	41	0.232	7.25	10.5	649	157	496	18
222	Basin	175	80	50	0.327	7	11.9	112.5	18	39	2
228	Earth Oven	170	120	54	0.779	222.89	6.8	1327.3	130	747	7
237	Earth Oven	210	200	68	2.019	545.2	53.7	3288.8	565	2265	10

BB#1 Exterior Pits											
Feature #	**Class**	**Length cm**	**Width cm**	**Depth cmbpz**	**Feature Volume screened m^3**	**FCR kg**	**Bone g**	**Shell g**	**Sherds**	**Sherds g**	**Bladelets**
246	Earth Oven	116	100	63	0.517	301.75	17.8	321.9	9	9	2
247	Earth Oven	96	92	45	0.281	74.7	112.5	117.5	38	122	4
283	Basin	120	115	30	0.17	2.7	10.6	25.4	3	7	10
308	Earth Oven	133	124	60	0.777	424.5	0.1	237	243	858	6
330	Basin	95	85	26	0.148	0	62.6	92.2	13	28	3
334	Basin	74	55	24	0.069	0	0	0	23	8	0
Totals					8.899	1824.94	4483.5	14382	3138	11282	117
19	Basin (1/2)	194	75	43	0.221	Not counted	0.6	0	5	13	0
197	Basin (1/2)	135	100	Undetermined	0.119	Not counted	0.1	30.2	23	23	0

BB#1 Structure Interior Pits

Feature #	Class	Length cm	Width cm	Depth cmbpz	Feature Volume screened m^3	FCR kg	Bone g	Shell g	Sherds #	Sherds g	Bladelets
13	Thermal Basin	104	78	13	0.055	11.75	10.9	48.2	21	41	1
15	Storage Pit	122	95	84	0.841	12.5	2.6	24.5	51	96	0
16	Thermal Basin	70	66	23	0.075	5	2.5	228.8	78	280	0
91	Thermal Basin	70	51	17	0.042	17	19	78.3	60	254	1
135	Thermal Basin	79	72	16	0.036	22	159.2	87.7	33	76	2
144	Basin	80	44	26	0.065	1.5	52	25.9	50	231	0
155	Thermal Basin	120	96	20	0.163	26	2.3	114.5	475	2497	1
167	Thermal Basin	95	90	23	0.133	24	121.7	196.6	92	354	0
Totals					1.41	119.75	370.2	804.5	860	3829	5

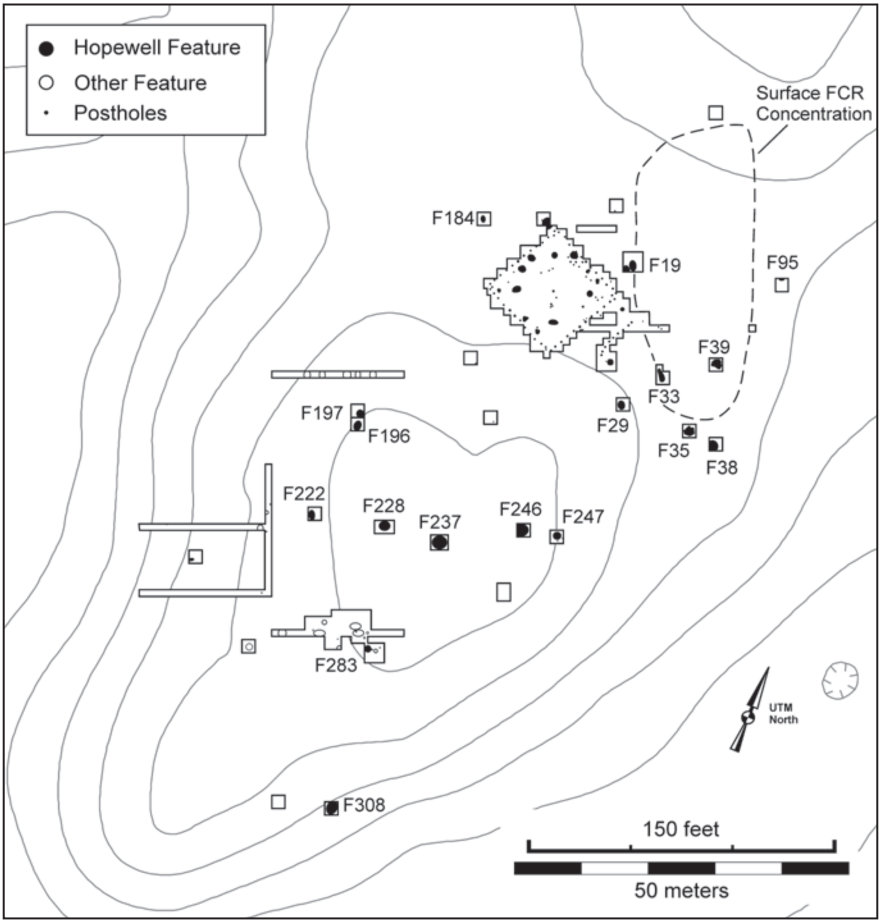

Figure 4. Plan view of 2005–2006 excavations at BB#1. Contour interval=10 cm; adapted from Pacheco et al. 2009a:Figure 13. See Kanter et al. 2015:Figure 7.2, for feature numbers within and immediately adjacent to structure.

southwest of the structure on the topographic high-spot. Earth ovens are exclusively located downwind and south of the structure. They are characterized by higher amplitude magnetic signatures, evidence of in situ burning, much higher densities of FCR, and in several cases abundant secondary refuse. Two distinctive patterns were observed in the earth ovens at BB#1, those which had been cleaned out and then subsequently used for secondary refuse disposal, and those in which the bottom layer of burning and FCR had been left intact. The four in the first group (F35, F38, F39, and F247), are closer to the structure, while the four in the latter group, (F228, F237, F246, and F308), are somewhat farther away.

The two graves, F33 and F95, were not included in Table 1. Both of these features were excavated in 2005, with F33 chosen in the purposive sample and F95 discovered by accident. The radiocarbon dates (see below) and osteological analyses identify these as Hopewell individuals. Burial One, an extended burial in F33, is a male, age 30–40 at time of death (Scuilli 2005). This almost complete individual is well preserved and is estimated to have been 168.2 cm tall, weighing 69 kg. Burial Two, in F95, is a flexed burial of a woman who was approximately 45 years old at time of death (Scuilli 2005). This grave was identified while we were excavating a stratigraphic unit on the eastern edge of the surface cluster of secondary refuse which is east of the structure. Burial Two is more fragmentary, but her height is estimated at 152 cm tall, with a weight of 50 kg.

Principal component analysis places Burial One near the center of the distribution of documented Hopewell individuals. It places Burial Two near the edge of the distribution, but still within the defined limits (Scuilli 2005). Burial Two had large osteophytes on the lumbar vertebrae and severe degenerative joint disease of the left scaphoid of the hand. Both individuals have heavily worn teeth, but only two dental caries were identified in Burial Two and none for Burial One. However, both individuals had lost teeth antemortem and had at least two abscesses (Scuilli 2005). Overall, the dental analysis for both burials indicates a non-maize diet, consistent with eating native Woodland foods. This interpretation is supported by the $\delta^{13}C$ ratios of -20.6 for Burial One and -20.7 for Burial Two, which are well below the ratios expected for individuals who regularly ate corn (Yerkes 2005).

Neither burial contained any artifacts or burial goods in direct association, although both have FCR placed over their joints. No other documented Hopewell burials are known from domestic sites in Ross County, but the number of excavated sites is woefully small and the discovery of burials in and around domestic houses is a cross-cultural characteristic of food-producing Neolithic-type peoples (Steadman 2015). Thus, while the discovery of burials certainly surprised us, their presence at the site is probably not that unusual. We would also note the recovery of a human burial at the Jennison Guard site, a domestic Ohio Hopewell settlement located at the mouth of the Great Miami River (Blosser 1996:57). Thus, all Ohio Hopewell people are clearly not buried in mounds.

In addition to pit features, other posts were found at BB#1. Though our approach initially was focused on locating and testing pit-type features, two small

Figure 5. Photograph of scale model of BB#1 structure based on results of the structural engineering analysis, shows shadows cast by posts in front of structure.

posts, perhaps indicative of drying racks or other similar small post constructions, were located outside the structure. More scattered posts likely would be found with additional testing. The bulk of the posts at BB#1, of course, comprise the walls and supports of the square structure, which measured 13.7 x 13.7 m (Figure 5) with an interior space of 189 m^2 (Kanter et al. 2015).

Four types of features were identified within the structure. These include four symmetrically placed hearths, which are also not listed in Table 1 because they lacked clear profiles and were devoid of cultural materials. Three pairs of what we interpret to be thermal basins, placed beneath benches, were located along every wall but the southeast. These pits had dense concentrations of FCR, but no evidence of in situ burning. We interpret them to have been used for passive heating (i.e., hot rocks were placed in them to heat the platforms above), but they were also convenient locations for secondary refuse. Two other internal pits include a single small basin, F144, which lacked the density of FCR found in the pairs of thermal basins, and a single, large (0.841 m^3), mostly empty and flat-bottomed pit, F15, surrounded by a series of small posts. We interpret F15 to have been a storage pit, with a screen or other related structure around/over it.

The organization of space at BB#1 forms a remarkably clear pattern with a total settlement area of just over 0.5 ha. The initial surface survey identified a concentration of FCR and debitage located about 15 m east of the structure (Figures 2 and 4). We think this is a secondary refuse dumping location for the house's occupants, albeit now somewhat spread by plowing. Originally, refuse was dumped on the surface. Now it is located entirely within the plow zone. A single 1 x 1 m unit placed at the edge of the concentration yielded the highest density of lithics recovered during plow zone screening. This refuse dump shares characteristics with the refuse dumps at Murphy I and III (Dancey 1991; Pacheco 2010), which were also confined to the plow zone. It is also a likely candidate for the general location of the 1963 excavations by Prufer, who commented in his field notes that "the count of fire-cracked-rocks in 50 sq. feet of sq. D was 1,700, with a lower limit at acorn size" (Prufer's field notes from August 11, 1963).

A number of pit features surround the structure in an arc running from the southeast to southwest (Figure 4), beginning about 20 m from the structure. Earth ovens and basins comprise this arc, extending out as far as 80 m in the case of F308. In the immediate vicinity of the structure are basin-shaped pits, while the two burials are within 20 m of the structure. The magnetic susceptibility data that we shared with Dalan (2008:20–21) shows that the structure area and an open yard just south of the structure, were likely maintained through sweeping and/or targeted avoidance as they have notably lower amounts of magnetically enhanced, burned sediments that would have been periodically cleaned out of thermal features like hearths or earth ovens. Overall, the organization of space at BB#1 provides strong support for our interpretation that this is a well-maintained Ohio Hopewell house-lot with a structure, secondary refuse dump, activity areas, an open yard, earth oven cooking zones, and burials.

At Lady's Run we excavated sixteen exterior Hopewell features (Table 2). With the exception of F681, a candidate for an exterior storage pit, the exterior pits all fall into the same two categories defined at BB#1: five represent earth ovens and six represent basins. All of the features with indistinct profiles were also basins, except F404, which may be a disturbance of some kind.

Although the overall size, quantity, and density of FCR in the earth ovens is lower at Lady's Run than BB#1, the earth ovens here also fall into two groups, those with intact layers of charcoal and rock at the bottom of the feature (F348B, F349,

Table 2. Data from Excavated Lady's Run Pit Features.

Lady's Run Exterior Pit Features											
Feature #	Class	Length cm	Width cm	Depth cmbpz	Feature Volume screened m^3	FCR kg	Bone g	Shell g	Sherds	Sherds g	Bladelets
341	Basin (1/2)	105	105	41	0.12	0.5	0	9.7	2	2	0
348A	Basin	80	72	25	0.102	13	0.9	0	24	53.2	0
348B	Earth Oven	85	85	45	0.255	42.5	37.2	168.1	115	188.2	1
349	Earth Oven	150	126	48	0.713	65.75	1.8	308.9	29	95.3	0
363	Basin	135	100	22	0.233	38.5	0	0.3	0	0	0
401	Earth Oven	152	118	60	0.761	10.35	49.5	311.7	116	177.3	2
403	Basin	106	106	30	0.265	23	35	261.2	124	395.3	1
405	Basin	41	29	27	0.022	7	0	7.5	8	15.1	0
412	Earth Oven	123	123	55	0.583	113.45	3.9	78.3	14	22.8	1
413	Basin	90	82	32	0.185	23.9	20.2	229.9	8	8.3	0
416	Earth Oven	88	78	37	0.199	99.25	1.4	59.3	68	100.7	0

Lady's Run Exterior Pit Features											
Feature #	**Class**	**Length cm**	**Width cm**	**Depth cmbpz**	**Feature Volume screened m^3**	**FCR kg**	**Bone g**	**Shell g**	**Sherds**	**Sherds g**	**Bladelets**
681	Storage Pit (1/2)	120	120	80	0.452	1	2.1	29.1	14	30.9	0
Totals					3.89	438.2	152	1464	522	1089.1	5
317	Basin	110	86	Undetermined	NA	0	2.8	117.2	2	6.2	0
360	Basin	92	82	Undetermined	NA	1.25	0	0.7	15	12.2	0
384	Basin	135	105	Undetermined	NA	0	0.9	23.1	10	15.1	0
404	Undetermined	100	50	Undetermined	NA	0.75	0	161.7	1	30.4	0
Lady's Run Structure 1 Interior Pit Features											
Feature #	**Class**	**Length cm**	**Width cm**	**Depth cmbpz**	**Feature Volume screened m^3**	**FCR kg**	**Bone g**	**Shell g**	**Sherds**	**Sherds g**	**Bladelets**
358	Thermal Basin	100	94	28	0.186	32.1	215.3	409.5	922	2182	3
359	Thermal Basin	75	65	20	0.0689	10.66	13.1	12.1	55	227	5

Lady's Run Structure 1 Interior Pit Features											
Feature #	**Class**	**Length cm**	**Width cm**	**Depth cmbpz**	**Feature Volume screened m^3**	**FCR kg**	**Bone g**	**Shell g**	**Sherds**	**Sherds g**	**Bladelets**
505	Storage Pit	160	96	78	0.941	6.05	2.6	73	68	98.3	0
512	Storage Pit	124	124	60	0.715	0	0	158	1	2.3	0
Totals					1.9109	48.81	231	652.6	1046	2509.6	8

Lady's Run Structure 2 Interior Pit Features											
Feature #	**Class**	**Length cm**	**Width cm**	**Depth cmbpz**	**Volume screened m^3**	**FCR kg**	**Bone g**	**Shell g**	**Sherds**	**Sherds g**	**Bladelets**
417	Thermal Basin	75	65	26	0.0995	7.15	20.7	222.6	336	1729.9	2
645	Thermal Basin	50	48	15	0.0282	1.95	4.5	60.4	86	94.7	0
667	Thermal Basin	40	35	13.5	0.0148	8.65	0	8.95	0	0	1
668	Basin	65	50	13	0.0332	10	9.6	88.8	17	40.9	0
673	Thermal Basin	80	80	17	0.0855	10.3	30.4	321.7	523	1453.4	1
Totals					0.2612	38.05	65.2	702.45	962	3318.9	4
710	Basin (Hearth?)	80	70	17	0.0383	0	0	0	0	0	0

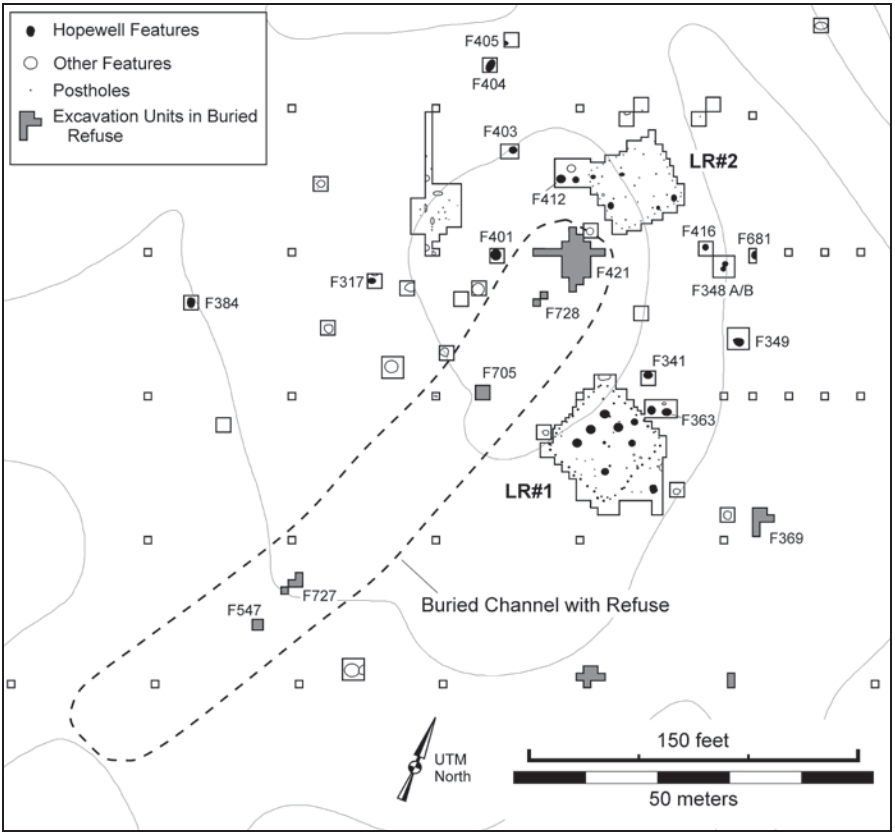

Figure 6. Plan view of 2007–2011 excavations at Lady's Run. Contour interval=10 cm. See Kanter et al. 2015:Figures 7.3 & 7.4, for feature numbers within and immediately adjacent to the structures.

F412, and F416) and those that had been cleaned out (F401). One notable difference between the two sites is that two of the earth ovens at Lady's Run, F412 and F348B, had companion basins associated with them, F413, and F348A, respectively. These basins may have functioned as processing pits during earth oven use.

Earth ovens at Lady's Run are distributed southeast, west, and southwest of Structure 2, which places them all north of Structure 1 (Figure 6). One possibility is that all of the earth ovens we investigated are associated with Structure 2, which would make their distribution similar to BB#1. The only exception might be the F412/F413 pair which is located just west of Structure 2; otherwise the ovens are downwind of the structure, so perhaps this pair is later. Accepting this scenario would leave Structure 1 with either no ovens or one. A solution to this conundrum may be that, as will be discussed below, if Structure 1 is contemporaneous with the BB#1 occupation, perhaps these undoubtedly related families did most of their outdoor oven cooking at BB#1.

Another possibility is that most of the Structure 1 earth ovens remain unexcavated. A few candidates exist northwest of the BB#1 structure and southeast of Structure 1 (see Figure 3 and Pacheco et al. 2009a:Figure 2, and Pacheco et al. 2009b:Figure 3). We explored two of these candidates, one in 2007 and the other in 2011; however, both turned out to be Late Woodland earth ovens.

Seven pit features were excavated within Structure 1, an 11.8 x 11.8 m square structure with 139 m^2 of interior space. There are a couple basins adjacent to the structure, F341 and F363, plus a couple more which had no diagnostic materials. Of these, F363 appears to be a cache of FCR, possibly for use within the structure. As with the BB#1 structure, the interior spaces of both Lady's Run structures were discussed in detail by Kanter et al. (2015), so the discussion here will be limited. Three of the features within Structure 1 were hearths (not included in Table 2), while the others included two large flat-bottomed storage pits, F505 and F512, and 2 shallow thermal basins, F358 and F359. Of the storage pits, F512 is noteworthy because it seems to have evolved during its use life from a storage pit into a hearth. Both of the thermal pits were rich in secondary refuse, with F358 particularly so.

Six pit features were excavated within Structure 2, a 10.1 x 9.6 m rectangular building with 97 m^2 of interior space. No hearths were identified in this structure, although the shallow basin F710 may have been a remnant of one based on the presence of abundant charcoal and no other artifacts. The other features include four thermal basins and a basin, F668, which was located in the west corner of the structure. This feature included a worked shell artifact and a large 8.5 kg slab of sandstone that was likely used as an anvil stone, indicating a spatially discrete activity area within the structure. The thermal basins in this structure were smaller than those in the other two structures, perhaps commensurate with the smaller size of the structure, but two of them, F417 and F673, were equally rich in secondary refuse.

The most distinctive difference between the features of Lady's Run and BB#1 is the presence of extensive deposits of buried secondary refuse at Lady's Run. As mentioned previously, buried secondary refuse was first discovered in 2007 and dubbed F421. In 2011, we placed additional units along the linear anomaly that stretches southwest of F421, discovering that it represents a 10 x 85 m buried channel, with depths extending from 60–90 cmbpz, i.e. up to 1.2 m below the surface (Figure 6). This paleochannel provides an excellent comparison to a similar deposit at the Smiling Dan site in the Illinois River Valley (Stafford et al. 1985), which was also used for secondary refuse disposal. One of the units placed in the center of the channel deposit revealed a Late Woodland–Jack's Reef layer (F705) overlying the Hopewell layer, which started at 60 cmbs.

A total of 18.8 m^3 of sediments were screened from the buried secondary refuse deposits. Extrapolating the density of some classes of artifacts, such as FCR, along the length of the channel produces staggering estimates for the amount of refuse contained in this deposit. For example, a total of 397.41 kg of FCR was counted and weighed from buried secondary refuse units, yielding an average of 21.14 kg per m^3 screened. Furthermore, the FCR within these deposits is on average smaller than FCR recovered from earth ovens, suggesting that it was discarded after being considered no longer useful. We have estimated the volume of the buried secondary refuse in the channel to be 678.08 m^3. Extrapolating the observed density of FCR across this entire volume produces a total of 14,334.61 kg. Excavations in the channel show that FCR is present throughout, but they also show that the density is highly variable, so this estimate is probably high. Nonetheless, the buried secondary refuse deposits no doubt contain thousands of kilograms of exhausted FCR.

Three other areas of secondary refuse were identified at Lady's Run. Two of these, directly south of Structure 1, turned out to be Late Woodland in origin, while the other, F369, located southeast of Structure 1, is Hopewell in origin. This refuse deposit is not located in a channel remnant or depression; instead, it appears to be an intact section of sheet midden preserved beneath the plow zone. The refuse here extended only a few cm below the plow zone, but otherwise it is similar to that found in the other buried deposits. There is a similar thin sheet of Hopewell refuse underlying the plow zone in the southern half of Structure 1 too, which continues outside the structure to the southwest. We were unable to determine stratigraphically if this refuse is related to the house occupation or if it post-dates its use. Both possibilities are equally viable.

DIAGNOSTIC OHIO HOPEWELL ARTIFACTS

A number of diagnostic Hopewell artifacts were recovered during the Brown's Bottom project. These diagnostics include large ceramic assemblages, bifaces, bladelets, mica, and rare items such as a small copper awl, a decorated bear canine, a small limestone bowl, and portions of a platform pipe; the latter three seemingly broken during manufacture. Discussion here will focus on material remains which are clearly diagnostic.

The total Hopewell ceramic assemblage from BB#1 consists of 4,473 sherds, weighing a total of 16.02 kg, minus the rim sherds which were not weighed because in many cases they have been refit to body sherds. Table 3 places all BB#1 sherds into recognized Ohio Hopewell ceramic series (Prufer 1968 ; Prufer and McKenzie 1965). The majority of sherds are grit-tempered and cordmarked (57.8%) vs. plain (16.8%) or indeterminate surfaces (25.4%). Decorated body sherds are rare (N=38), and it appears that many of these (73.7%) are from just two vessels. An estimated minimum number of 61 vessels are represented in the assemblage based on rim sherds and unique body sherds.

Table 3. Brown's Bottom #1 Ohio Hopewell Ceramic Assemblage.

Ceramic Series	Body Sherds %	Body Sherds	Rims %	Rims	Assemblage %	Total of all sherds	Vessels %	Vessels MNI
Scioto Series	99.13	4319	93.97	109	98.99	4428	73.77	45
Hopewell Series	0.16	7	3.45	4	0.25	11	11.48	7
Southeastern Series	0.7	31	2.59	3	0.76	34	14.75	9
Totals	99.99	4357	100.01	116	100	4473	100	61

Measurements of rim, neck, and body sherd thickness produced the following results: average thickness of rim sherds=6.1 mm, sd=1.7 mm; average thickness of neck sherds=6.5 mm, sd=1.5 mm; and average thickness of body sherds=5.6 mm, sd=1.3 mm. These metrics are consistent with other published Middle Woodland assemblages in Ohio (Dancey 1991; Prufer 1968; and Prufer and McKenzie 1965).

The mode for orifice diameter in the 25 vessels that could be measured is 22 cm, while the range goes from 10 cm to 25 cm. Accurate measurements for three vessels with orifice diameters greater than 25 cm could not be obtained; however, they do not appear to be larger than 28 cm in diameter.

One typical Scioto series vessel with a plain rim from F38 deserves mention. It comes from a large globular jar, but with an orifice diameter of only 10 cm it is appreciably narrower at the mouth than other similar vessels in the assemblage, a trait typically considered to represent storage containers (Robertson 1983). This vessel's presence in the assemblage is important because it shows that storage took place in specialized ceramic vessels, as well as within subsurface pits. Similarly, Aimers (2004:105) noted with respect to Maya ceramics that: "Long-term dry storage vessels may also have rolled over or everted rims possibly for a pliable cover for protection from insects and dirt." Rolled over and everted rims are common in the

Hopewell ceramics recovered from Brown's Bottom, perhaps indicative of wide spread ceramic storage.

The majority of the BB#1 sherds in the assemblage were recovered from seven features (see Table 1). Of these, only F155 and F196 are not earth ovens. F155 is a shallow basin-shaped thermal feature located along the northwest wall of the structure. A distinctive embossed rim from a Southeastern series Turner Diamond Check-Stamped vessel (see Pacheco et al. 2005:Figure 4) was recovered from this pit, which refit with several check-stamped body sherds. A well-preserved cordmarked basal sherd with a tetrapod was recovered from F196 (see Pacheco et al. 2009a:Figure 6), which might go with the possible tool kit recovered from this feature.

A total of 109 rim sherds, which are typically outward flaring or everted, were assigned to the Scioto series, representing a minimum number of 45 vessels. Many of these Scioto series cordmarked vessels have plain rims and necks above cordmarkings extending across the rest of the vessel. The overwhelming abundance of Scioto series pottery, plus the common occurrence of burned interiors indicative of cooking on some of the pots, suggests these vessels were used as utilitarian ware.

Three rim sherds and 31 of the decorated body sherds were assigned to the Southeastern series, representing a minimum of nine vessels. Of these, six body sherds belong to the subtype Turner Simple Stamped A; all are different enough in terms of temper and width of the stamps to likely originate from separate vessels. Another thermal feature interior to the structure, F91, had a unique Southeastern series body sherd with a row of three small punctates running across its surface, each of which has a small incised line extending from it parallel to the body of the vessel; essentially a "lollipop" motif. Two of the rim sherds and twenty-four body sherds belong to the embossed Turner Diamond Check-Stamped vessel from F155.

The assemblage includes a minimum number of seven Hopewell series vessels. A small Chillicothe Zoned Incised rim sherd was recovered from F35 that refit with several body sherds containing hemi-conical punctates. There are two zoned Dentate stamped sherds, one of which is a rim sherd from F237 and the other is a neck sherd from the plow zone interface within the structure. An incised sherd with a hemi-conical punctate was recovered from F237 and represents a vessel similar to the one in F35. An untyped incised body sherd was recovered from F39. Finally, two distinctive everted thick plain rim sherds, representing Brangenberg rims were recovered from F29. Only a single Chillicothe Rocker Stamped body sherd is present in the assemblage.

Lady's Run produced a larger, but more fragmentary, Hopewell ceramic assemblage of 7,552 sherds, weighing a total of 16.98 kg, again minus the rim sherds.

One likely reason for the elevated fragmentation at Lady's Run is weathering within the secondary refuse deposits, where the sherds probably sat exposed after deposition. A sub-sample of 1,669 sherds from F421 weighed on average only 1.5 g each (D'Amico and Pacheco 2008), documenting the degree of fragmentation and weathering. Just under half (48.6%) of the sherds from this site come from such deposits as opposed to interior and exterior pit features (see Table 2).

Table 4 assigns the Lady's Run sherds to the Ohio Hopewell ceramic series. Again, the majority of sherds are grit tempered and cordmarked (42.3%) vs. plain (31.4%) or indeterminate surfaces (26.3%). Decorated body sherds make up only 0.72% of all body sherds and most of these (N=41 or 71.9%) come from a single simple stamped vessel. Based on the rims and unique body sherds, the assemblage represents an estimated minimum number of 70 vessels.

Table 4. Lady's Run Ohio Hopewell Ceramic Assemblage.

Ceramic Series	Body Sherds %	Body Sherds	Rims %	Rims	Assemblage %	Total of all sherds	Vessels %	Vessels MNI
Scioto Series	99.27	7354	88.2	127	99.06	7481	81.4%	57
Hopewell Series	0.094	7	9.03	13	0.26	20	12.9	9
Southeastern Series	0.634	47	2.77	4	0.68	51	5.7	4
Totals	100	7408	100	144	100	7552	100	70

Thickness metrics from Lady's Run are generally similar to BB#1. Measurements of the rim, neck, and body sherds produced the following results: average thickness of rim sherds=6.6 mm, sd=1.4mm; average thickness of neck sherds=6.1 mm, sd=1.0 mm; and average thickness of body sherds=5.0 mm, sd=1.0 mm.

The mode for orifice diameter of the seventeen vessels which could be measured is 21 cm, while the range goes from 9 cm to 23 cm. The vessel with the smallest orifice diameter is likely a cup, which has distinct thumbnail impressions along its rim. One vessel with a narrow orifice diameter of 13 cm from F527, refuse located within the southern half of Structure 1, is considered to be another candidate for a storage vessel.

A total of 127 mostly outward-flaring and everted rim sherds were identified as Scioto series, corresponding to an estimated minimum number of 57 vessels. Many of these vessels also have a combination of plain necks and rims with cordmarked bodies, but there seem to be more completely plain pots at Lady's Run, as reflected in the higher proportion of plain sherds. Ten plain sherds exhibit a white slip, which is a rare trait in Hopewell assemblages.

Four rim sherds, 46 simple stamped body sherds, and a small tetrapod were assigned to the Southeastern series, representing a minimum of four vessels. The tetrapod comes from a small, fine-grit tempered vessel recovered from F358 within Structure 1. Most of the stamped sherds, and all of the rims, come from the same reddish colored, micaceous sand tempered Turner Simple Stamped B vessel. This vessel was recovered from F727 in the paleochannel and is most certainly a nonlocal import.

A minimum number of nine Hopewell series vessels are represented in the assemblage by twenty combined rims and decorated body sherds. At least three of these vessels represent Chillicothe Incised and there is one notable small cross-hatched Hopewell series rim sherd from F728 within the paleochannel. Three distinctively everted, thick and plain Brangenberg rim sherds from the same vessel were recovered in F421. Finally, as at BB#1, there was only a single Chillicothe Rocker Stamped body sherd present in the assemblage. Fine decorated Hopewell pottery, which is common in mound and earthwork contexts in the region (Prufer 1968), is a rarity in Brown's Bottom assemblages.

The Middle Woodland biface assemblages from BB#1 and Lady's Run are not large (BB#1 N=20; Lady's Run N=18), but all specimens with the exception of a large partially thinned Wyandotte preform from F358 at Lady's Run, are completely thinned. Most specimens are broken; presumably from use (only four preforms and three projectile points are whole). Biface specimens include tips, midsections, bases, preforms (cache blades), and eight classic Middle Woodland convex based projectile points, with four from each site. Combining the two assemblages, 71% of the biface specimens are made out of Vanport chert, 18.4% are Upper Mercer chert, 5.2% are Wyandotte, and 2.6% each are Brush Creek and Delaware chert. Vanport chert accounts for less than 10% of the total Hopewell lithic artifact assemblages from each site, but it dominates the biface and bladelet assemblages, showing that it was selectively used for these types of tools. In contrast, locally available Delaware and Columbus cherts dominate both clearly Hopewell debitage assemblages. The same overall pattern of chert raw material use was also observed at the McGraw site (Pi-Sunyer 1965).

The most common diagnostic Hopewell lithic artifacts in both assemblages are bladelets. An analysis of the BB#1 bladelets (Table 5) has been published (Snyder et al. 2008), so contrasting them with the Lady's Run bladelets (Table 6) is the main focus here. As the tables show, both assemblages are remarkably similar in terms of thickness, platform length, and platform width. The Lady's Run bladelets appear slightly narrower, but the difference is not statistically significant (t=.812, p=.418). The only statistically noticeable difference is that the whole Lady's Run bladelets are about half a cm smaller in length than the whole BB#1 bladelets (t=3.45, p=.001).

Table 5. Brown's Bottom #1 Ohio Hopewell Bladelet Statistics for the Complete Assemblage (N=185), adapted from Snyder et al. (2008:48).

Brown's Bottom #1 Bladelet Assemblage	Width cm	Thick-ness cm	Length cm	Platform Length cm	Platform Width cm
N Valid	184	185	37	79	79
Missing	1	0	148	106	106
Mean	.9530	.2424	3.7622	.2367	.1187
Std. Error of Mean	.0159	.0049	.1123	.010	.0163
Median	.9320	.2360	3.90	.2250	.0860
Std. Deviation	.2161	.0670	.6832	.0889	.1448
Skewness	1.186	.729	-.030	.579	4.917
Std. Error of Skewness	.179	.179	.388	.271	.271
Kurtosis	2.527	.585	-.333	-.036	25.0
Std. Error of Kurtosis	.356	.355	.759	.535	.535

Table 6. Lady's Run Ohio Hopewell Bladelet Statistics for the Complete Assemblage (N=90).

Lady's Run Bladelet Assemblage	Width cm	Thick-ness cm	Length cm	Platform Length cm	Platform Width cm
N Valid	90	90	34	41	44
Missing	0	0	56	49	46
Mean	.930	.2417	2.932	.2601	.1519
Std. Error of Mean	.0242	.0078	.2193	.0187	.0187
Median	.900	.230	3.0455	.230	.10
Std. Deviation	.2296	.0738	1.2787	.1198	.1241
Skewness	-.018	1.705	.296	.690	2.083
Std. Error of Skewness	.254	.254	.403	.369	.357
Kurtosis	2.617	4.912	-.746	.611	4.254
Std. Error of Kurtosis	.503	.503	.788	.724	.702

The bladelets from BB#1 and Lady's Run are narrow and thin, with a combined 75% exhibiting trapezoidal cross-sections. There is no evidence supporting extensive bladelet manufacturing at the sites. Only one bladelet core rejuvenation flake was recovered at Lady's Run, while at BB#1:

> Only three exhausted bladelet core fragments were recovered during the investigations. The largest weighs 35.2 grams and has three bladelet removal scars. This core fragment, recovered from a plow zone context within the structure, is made of Upper Mercer chert. The other two bladelet core fragments are Vanport (Flint Ridge) chert. The larger of the two Vanport fragments is badly burned and weighs 20.7 grams. It was recovered from the surface near the cluster of earth ovens south of the structure. The smaller fragment is heat treated and weighs only 1.7 grams. Interestingly, it was found in the fill of Feature 167, one of the thermal features within the structure. The structure also produced a number of bladelets. One complete Vanport chert bladelet, Item #56, was recovered from Feature 137, one of the large, primary post molds located along the southwest wall of the structure. In all, 20 whole and fragmentary bladelets were recovered from contexts near or within the structure, which suggests that the structure was a focal point of bladelet use and discard, and possibly some limited production [Snyder et al. 2008:45].

The same focus for bladelet use and discard is true for Lady's Run; thirteen bladelets were recovered from within the contexts of Structure 1, with eight coming from thermal basins, F358 and F359. Similarly, nine bladelets were recovered from within the contexts of Structure 2, with four coming from thermal basins, F417, F667, and F673, and four coming from F670, a large interior post mold. The one notable exception to this pattern of recovering bladelets from the structure contexts was F196 at BB#1, which was discussed above.

As mentioned, the dominant raw material in the bladelet assemblages is Vanport chert. The BB#1 bladelets are 91.8% Vanport (N=170), and the Lady's Run bladelets are 82.3% Vanport (N=74). Wyandotte chert is present in minor proportions in both assemblages as well (BB#1 N=2; Lady's Run N=5). The preference for high quality raw material for making bladelets has long been recognized (Greber et al. 1981).

Finally, it should be mentioned that the sourcing study done by Hill et al. (this volume), interpreted a few bladelet specimens that we identified as Vanport chert to be Burlington chert from Illinois. If so, these bladelets would represent additional exotic materials in the site assemblages. However, all of these possible Burlington bladelets were manufactured in the Ohio style rather than the Illinois style (Pi-Sunyer 1965).

Exotic Hopewell artifacts are relatively rare at BB#1 and Lady's Run. Mica is the most common of the exotica. Mica fragments or scraps were recovered from two of the eight interior pit features, and six of the seventeen exterior pit features at BB#1. Notably, a large broken piece of cut mica was recovered from F16, a thermal basin inside the structure (see Pacheco et al. 2005:Figure 9). At Lady's Run, mica fragments were recovered from one interior pit in each of the structures, and were scattered throughout the buried secondary refuse deposits, with scraps in several units on the north end of the paleochannel and 60 meters or so away to the south as well. No mica was recovered from the exterior pits at Lady's Run, but the readily available refuse dump in the paleochannel may be why.

Though rare, a few other exotic artifacts were also found. For example, the only worked slate was recovered during the initial surface survey within BB#1. Three whole stone celts were recovered at Lady's Run and a fragment of a stone celt was found during the surface survey at BB#1, but these artifacts are not clearly Hopewell. The complete small copper awl from F196 at BB#1 (see Pacheco et al. 2009a:Figure7) is clearly Hopewell. Interestingly, a recent sourcing study (Hill et al. 2018; Nolan et al., this volume) concludes that it comes from a southern Appalachian source instead of the more typical northern Lake Superior region source.

A pair of unique items was recovered from F403 at Lady's Run, a basin located just west of Structure 2. The first of these is a longitudinally split and worked bear canine with a grid pattern of punctations on the root (see Pacheco et al. 2009b:Figure 10). The canine broke while perforations were being added to its back side. We would also note that the root end of another drilled and worked bear canine was recovered by Wymer in the flotation heavy fractions from F421 at Lady's Run.

The second artifact from F403 is a small limestone bowl or cup (see Pacheco et al. 2009b:Figure 11) that is somewhat similar to one found at the American Bottom Holding site (Fortier et al. 1989). After reassembly of several fragments, it became apparent that the hole in the bowl's side has a beveled edge. The beveling suggests that the hole was intentionally made through the removal of several flakes. Instead of a cup, this object could be a type of pipe not seen before at Hopewell sites. The cup may also have been broken in manufacture, and then a failed attempt to convert it into a pipe resulted in its discard with other refuse in F403. Both unique items in F403 appear to have been broken in manufacture.

The final unique diagnostic artifact is the majority of a Hopewell platform pipe refit from five fragments (see Pacheco et al. 2009b:Figure 5). These fragments were recovered in F421 at Lady's Run in four separate, but spatially connected 1 x 1 m units.

Since F421 is below plow disturbance, this distributional pattern indicates that the pipe was broken elsewhere and then the fragments were gathered up and unceremoniously tossed into the trash—perhaps from within the confines of a gathered hide or basket. The pipe could not have been deposited while intact. Preliminary visual inspection suggests that it broke during manufacture, and there is no evidence of any residue or discoloration that might be expected from use. The material used in the pipe's manufacture has been confirmed as Ohio pipestone using PIMA (Portable Infrared Mineral Analyzer), likely quarried at Feurt Hill near Portsmouth, Ohio.[1]

MIDDLE WOODLAND CHRONOLOGY

There are sixteen radiocarbon dates from Hopewell contexts at BB#1 (Table 7) and Lady's Run (Table 8), eight from each site. The number of dates was recently doubled through generous funding provided by Nolan et al. (2017). Dated samples include AMS dates on bone collagen from the two human burials, conventional dates on wood charcoal and nutshell, and AMS dates on charred branches, nutshell, and a tuber.

Table 7. Calibrated Ohio Hopewell Radiocarbon dates for Brown's Bottom #1. Calibrated with Calib 7.0.4.*

Sample #s	Context	Sample	Convent. C14 Age	Most Prob. 2 Sd Range	Prob.	Median Prob.
Beta - 206784	F33 - Burial 1	AMS Bone Collagen	1610±40 BP	350–367 AD 379–546 AD	.022 .978	461 AD
Beta-213518	F95 - Burial 2	AMS Bone Collagen	1720±40 BP	235–405 AD	1.00	321 AD
UGAMS-28068**	F237 - Earth oven	AMS Nutshell	1710±23 BP	255–302 AD 315–394 AD	.3 .7	340 AD
UGAMS-28066**	F35 - Earth oven	AMS Nutshell	1760±23 BP	219–348 AD	.996	289 AD
Beta - 206255	F38 - Earth oven	Wood	1750±60 BP	131–404 AD	1.00	285 AD

Sample #s	Context	Sample	Convent. C14 Age	Most Prob. 2 Sd Range	Prob.	Median Prob.
UGAMS-28067**	F196 - Exterior Basin	AMS Tuber	1780±23 BP	209–265 AD 270–332 AD 141–196 AD	.45 .44 .11	253 AD
UGAMS-28065**	F167 - Thermal Basin in Structure	AMS Nutshell	1820±23 BP	129–247 AD	1.00	188 AD
Beta - 210517	F135 - Thermal Basin in Structure	Composite Wood	1890±50 BP	15–240 AD	.996	119 AD

*Stuiver and Reimer 1993 **Nolan et al. 2017

Table 8. Calibrated Ohio Hopewell Radiocarbon dates for Lady's Run. Calibrated with Calib 7.0.4.*

Sample #s	Context	Sample	Convent. C14 Age	Most Prob. 2 Sd Range	Prob.	Median Prob.
Beta-242883	F421- Buried refuse 35–45 cmbs 1940E/2139N	Nutshell	1650±60 BP	252–308 AD 310–542 AD	.116 .884	399 AD
Beta-242884	F468 - Center-post Structure 1	AMS Coffee-tree Branch	1710±40 BP	242–409 AD	1.00	333 AD
UGAMS-28069**	F358 Thermal Basin in Structure 1	AMS Nut-shell	1720±23 BP	252–307 AD 311–387 AD	.41 .59	326 AD
UGAMS-28071**	F547 Buried refuse 60cmbs 1896E/2089N	AMS Nut-shell	1790±23 BP	137–260 AD 279–325 AD	.74 .26	237 AD

Sample #s	Context	Sample	Convent. C14 Age	Most Prob. 2 Sd Range	Prob.	Median Prob.
Beta-293547	F673 - Thermal Basin in Structure 2	AMS Nutshell	1780±30 BP	138–200 AD 205–334 AD	.182 .818	252 AD
Beta-242885	F403 – Exterior Basin near Structure 2	AMS Coffee-tree Branch	1800±40 BP	125–338 AD	.998	220 AD
UGAMS-28070**	F421 Buried refuse 38–45 cmbs 1941E/2140N	AMS Nutshell	1810±24 BP	130–255 AD 300–317 AD	.96 .04	199 AD
UGAMS-28072**	F727 Buried refuse 40–70 cmbs 1905E/2095N	AMS Nutshell	1910±23	28–39 AD 50–133 AD	.02 .98	94 AD

*Stuiver and Reimer 1993 **Nolan et al. 2017

Perusal of the dates show two outliers, one on each end. The youngest of these, spanning from AD 350–500, is for Burial One. This burial seems to have been purposively placed out in front of the BB#1 doorway; long after the BB#1 structure had been abandoned. The oldest outlier, spanning AD50–130, is from F727 at Lady's Run, located in the southwestern portion of the paleochannel. This feature produced the nonlocal Turner Simple Stamped B vessel. Interestingly, the date for F547, which is located just southwest of F727, just misses overlapping the F727 date around AD 140. We note that these areas of the paleochannel are located in proximity to the third cluster of magnetic anomalies shown in Figure 3, which we were unable to investigate. This cluster is west of BB#1 and southwest of Lady's Run on the third topographic rise. Both Blank's (1965) map and Prufer's 1963 field notes indicate a third cluster of Hopewell material west of cluster one and southwest of cluster two. Thus, while outlying dates reflect occupations which are not well represented in excavated remains during the project, they likely document long term shifting Hopewellian use of the Brown's Bottom landscape both before and after the main occupations, with a possible indication of where the earlier household was located.

All of the other fourteen dates overlap with each other at about AD 250, allowing for a small effect from old wood in the composite sample from F135 at BB#1. This is not to say that all of the occupations occurred at this time, as undoubtedly they did not, especially when taking into account the probability levels for the different time ranges associated with each date. It does mean, however, that radiocarbon alone cannot delineate a conclusive sequence of occupations. Taken together though, the dates suggest an intensive period of Hopewell occupation on the Brown's Bottom landscape from about AD 200–350. During this time, evidence for shifting Ohio Hopewell extended family households on the bottoms is well documented. Excavation of the third cluster might have been able to push the beginning of this intensive occupation back to AD 100.

A tentative interpretation of the occupation sequence, rounded to the nearest decade, is based on dates from associated contexts. Lady's Run Structure 2 is dated by F673 and nearby dates for F421 and F403. These dates overlap with high probability from AD 140–250, centering on AD 220. Excluding the date for Burial One, BB#1 has a fairly tight set of dates which overlap with high probability at AD 240, but treating F135 as slightly too early due to old wood, pushes this date to AD 250. As long as F167 is not treated as a terminus date for the structure, and there is no reason to think that it is, three other dates from nearby earth ovens and basins provide an occupation time span from AD 250–300, centering on AD 270. The F237 earth oven also fits into this time span, but with lower probability. Lady's Run Structure 1 is dated by F468, F358, and the younger date from F421. These three dates overlap with high probability from AD 310–390, centering on AD 330, and with lower probability from AD 250–310. The F547 date has a lower probability time span from AD 280–325, which would overlap with both of these ranges.

To summarize, the sequence of Hopewell occupations on Brown's Bottom may have started in the unexcavated third cluster around AD 100–150. Lady's Run Structure 2 came next, sometime between AD140–250, centered on AD 220. BB#1 was next in the sequence, spanning a period from AD 250–300, and centered on AD 270. Lady's Run Structure 1 came last, with highest probability after AD 310, and centering on AD 330. There is also the possibility that Lady's Run Structure 1 overlaps a portion of the later part of the BB#1 occupation. Assuming Lady's Run Structure 1 survived longer, an intriguing explanation is that the Lady's Run household buried the male in Burial One, outside the BB#1 structure, still knowing through group memory where the entrance was located. This event took place sometime around or after AD 350, at the end of the Hopewell occupations on the bottoms.

SEASONALITY AND DEER HUNTING PATTERNS ON BROWN'S BOTTOM

INTRODUCTION

Archaeologists approach seasonality through a number of different kinds of analyses, ranging from subsistence data through the organization of site structure. While we have abundant evidence of Hopewell plant utilization from the Brown's Bottom project documenting spring through fall occupation of the sites, assessing winter occupation is often difficult. In this section, we focus on the faunal evidence for seasonality based on deer remains and deer hunting patterns. At the end of the section, we present a composite view of the seasonality evidence from BB#1 and Lady's Run, combining the faunal, plant (see Wymer, this volume), and site structure data (Kanter et al. 2015).

A total of 1,997.8 g of bone were recovered from all Hopewell contexts at Lady's Run. A vast majority of this bone, 70.6% representing 1,410.7 g, was recovered from F421, demonstrating patterned disposal of faunal remains in the secondary refuse. Exterior pit features, interior pit features from the two structures, and buried remnant sheet midden deposits account for the rest. Most of the bones recovered from Lady's Run, including those in the buried secondary refuse deposits, are weathered, fragmentary, and small. A very weathered and eroded sample of 1,354 bone fragments from F421 collected in 2007, documents this pattern. Fragments have an average long axis of 13.9 mm, and an average weight of just under 0.4 g. Additionally, 485 fragments weighed under 0.1 g, which is the lowest exact weight available on our scale (D'Amico and Pacheco 2008). Notably, a few of these F421 bones exhibit polishing and incising indicative of decorated bone tools, but overall bone preservation was poor.

As a consequence of poor preservation, identification of bones to the species level at Lady's Run proved futile in most cases. Notable exceptions to the lack of species-level identification include several probable dog teeth from F403, two raccoon molars, a loose human incisor, and several deer long bones and loose teeth recovered from F421, deer antler tine tools recovered from thermal basins located within both structures, and a large shed deer antler from F358 within Structure 1. While not identifiable to the species level, numerous fish ribs and vertebrae were recovered from the interior pits and posts of Structure 2.

In contrast, a slightly more robust, significantly less weathered, and somewhat less fragmentary sample of 4,946.9 g of bone was recovered from all Hopewell contexts at BB#1. This total does not include the remains of the one almost complete domesticated dog from F38 (see Pacheco et al. 2005:Figure 3) or the human remains in F33 and F95. Most of the bones, representing 98.2% of the total, were recovered from exterior and interior pit features, while the rest were found in post molds. Screening plow zone was not a priority in the research design, yet an additional 211.8 g were recovered from the plow zone. Presumably these bones are associated with the Hopewell component given the spatially discrete organization of the site, and the presence of features in the sub-plow zone of these units. Bone preservation at BB#1 may have been improved by the high volume of shellfish recovered in some of the exterior pit features (see Table 1).

Inspection of the faunal assemblage was completed in September 2006 by Dr. J.E.B. Bowen. Excluding the human remains and the numerous dog bones from F35 and F38 (MNI=4: one complete dog skeleton, three partial), Bowen identified 228 other specimens to the species level, with 207 (90.8%) of these representing white-tailed deer (*Odocoileus virginianus*), 16.9% of which are loose teeth. The remaining twenty-one identifiable bones belong to turkey (MNI=4), raccoon, woodchuck, beaver, gray squirrel, snapping turtle, and box turtle (all with an MNI=1). Fish bones were recovered in F38, and numerous bird bones were recovered from several pits. Although these could not be identified to species level, many of the unidentified bird bones probably represent turkey.

If we use the most common element to calculate the MNI represented by the sample (right deer astragali from BB#1) deer have an MNI of six. This estimate is no doubt too conservative, especially given that five of these right astragali are from F38. In fact, Bowen provided estimated ages for 13–14 separate individuals. The reason for the variable number of individuals with estimated ages is that F35 has multiple loose molars determined to have come from two old deer, one 5–6 years old and the other 6–7 years old. However, older deer are problematic to accurately age (Wolverton et al. 2008:10), so these teeth are not necessarily from different individuals. There are two right distal tibiae in F35, plus the antlers of a young buck with an age estimate of 2.5 years old, thus the MNI for this feature is 2–3. Finally, if we calculate the site MNI based on feature context, assuming most pit features, especially earth ovens, were not open at the same time, then the total deer from the sample produces an MNI of 21–22 deer. This latter figure is considered a closer approximation to the number of deer represented by the sample.

A majority of the 166 (80.2%) identifiable deer bones from BB#1 were found in three earth ovens (F35, F38, and F39) located southwest of the structure (see Figure 4). Similarly, the majority of all bones (82.9%, representing 4,099.5 g plus the complete dog) from all Hopewell contexts are from these three pits. Of these pits, F38 has the most identifiable deer bones (N=105). Notably, although all of these features produced shellfish, F38 has the most—6,211.7 g—of any feature excavated during the project (see Tables 1 and 2). The buried secondary refuse deposits at Lady's Run did yield a combined total of 7,215.3 g of shellfish, but these fragments were spread through 18.8 m^3 of screened fill, with some units spaced over 60 m apart. Thus, the calcium carbonate from the shellfish did not have as much impact on bone preservation at Lady's Run.

In sum, the recovered and identifiable faunal assemblage from BB#1 exhibits the same pattern as other documented Middle Woodland habitation sites across the Eastern Woodlands, with white-tailed deer representing the most common identifiable bones in all assemblages (Pacheco and Dancey 2006:15). For comparison, 75% of the identifiable 530 mammal bones from McGraw, which had remarkable preservation, are from deer (Parmalee 1965:115), while 74% of the 258 identifiable mammal bones at Jennison Guard are deer (Blosser 1996:63). Deer are by far the most important animal resource that Holocene Eastern North American people relied upon given the lack of domesticated food animals, the relative abundance of deer in Holocene fauna, and the ability of deer to withstand substantial predation before declining in numbers (Ford 1979; Pacheco and Dancey 2006; Wolverton et al. 2008).

SEASONALITY

Looking at the subset of deer with age estimates, it is possible to assess seasonality of when these deer, or parts of the deer in the case of the shed antlers, were harvested or collected. Examination of Table 9 shows that deer or deer parts were being exploited at BB#1 in every season.

Table 9. Ohio Hopewell Deer Seasonality Evidence from Brown's Bottom #1.

Feature #	Feature Type/ Location	FS #	Identification	Age	Month of Harvest
135	Thermal Basin within Structure	227	right shed antler, diameter =34 mm	Estimated age 5½–6½ years	January–March
167	Thermal Basin within Structure	243	left shed 4-point antler, diameter = 22mm	Estimated age 2½ years +	January–March
237	Earth Oven Side Yard	327	left shed antler, diameter = 24 mm	Estimated age 2½ years +	January–March

Feature #	Feature Type/ Location	FS #	Identification	Age	Month of Harvest
38	Earth Oven Front Yard	77	right anterior mandible, M3 beginning or about to erupt	Estimated age 10–11 months	March–April
38	Earth Oven Front Yard	134	frontal w/ attached antler, velvet growing	Estimated age 2 ½ years +	April–June
38	Earth Oven Front Yard	211	left anterior mandible, permanent PM 1 erupting	Estimated age less than 18 months	September–November
39	Earth Oven Front Yard	91	PM 3 deciduous, heavily worn, 3 cusps	Estimated age 15–17 months	August–November
29	Basin Front Yard	30	frontal w/ attached antler, no velvet, highly eroded	Estimated age 2½ years +	August–December
35	Earth Oven Front Yard	63	frontal w/ attached antler, no velvet, diameter = 25 mm	Estimated age 2½ years	August–December

Antlers provide evidence for three to four different seasons of exploitation. Shed antlers represent collection during winter for two reasons. First, white-tailed bucks shed their antlers between late December and early March. Second, because they have a high protein content and are calcium phosphate rich, there is heavy predation on antlers by rodents as soon as they are shed (Flinn et al. 2012:3), making them rare finds. Thus, shed antlers are very likely to have been acquired from about January through March. Interestingly, two of the three shed antlers from BB#1, and the only shed antler recovered from Lady's Run, come from thermal basins inside structures. One possible explanation for antlers in thermal basins is that they were used as hand-held, "tong-like" tools to transport hot rocks from the hearths to the thermal basins, where the hot rocks then served as a source of passive heat under sleeping benches (Kanter et al. 2015).

The other antlers found at BB#1 provide seasonality data by virtue of their state of development. A deer cranial frontal piece with the antler still attached was recovered from F38. This antler was still in velvet and had just begun to develop;

consequently, it represents a deer harvested between April and June, since bucks start to grow their antlers again in April and they stop growing by August (Flinn et al. 2012:3). Partial deer cranial frontals recovered from F29 and F35 had attached antlers that were fully developed without velvet. In preparation for the rut, bucks rub off their velvet beginning in late August - September, so attached antlers without velvet represent fall harvests.

Additional evidence for fall harvests comes from two deer mandible fragments, each with teeth, recovered in F38 and F39. More precise age estimates for deer can be made for young individuals because of the presence and loss of deciduous teeth. In the case of the F38 specimen, this fragment of the left anterior mandible has a permanent PM1 erupting. These teeth erupt in yearling deer before they are 18 months old. Since white-tailed deer are born between mid-May and mid-June, this deer was harvested between September and November (Cain and Wallace 2003). In the case of the F39 specimen, the deciduous PM3, identified based on the presence of three cusps, is still present and is heavily worn, indicating a deer between 15–17 months old (Morris 2015:345). This yearling would have been harvested sometime between August and November.

Perhaps the most intriguing specimen is a fawn's mandible fragment with teeth from F38. This specimen represents a fragment of the right anterior mandible and exhibits M3 just beginning, or about to erupt. In white-tailed deer this tooth erupts from 10–13 months old (Morris 2015:344). Bowen estimated the age of this fawn to have been between 10–11 months old, suggesting harvest sometime in the late winter-early spring between March and April.

Together, the Table 9 data provide specific evidence for seasonality being represented in the pit features. F38 contains the 10–11 months old fawn, the buck with antlers still in velvet, and the less than 18 months old yearling, based on the erupting permanent PM1. Thus, deer in F38 represent March–November harvests, with notable late winter–late spring specimens. In contrast, deer from F29, F35, and F39 indicate exclusively fall harvests. Both F29 and F35 have frontals with antler out of velvet, putting these hunts in the late August to December range. The F39 deer is the 15–17 months old yearling, based on the highly worn deciduous PM3, which was harvested from August to November. Fall harvests between mid-October and December coincide with the rut, when deer are less cautious, and fattened for winter. Modern state hunting seasons also recognize this as the best time to hunt deer.

As noted, F38 has an MNI of five deer, based on the presence of five right astragali, but there are also portions of five separate deer heads from this feature that have nonoverlapping age estimates. Likewise, F35 has an MNI of 2–3, based on the presence of two distal right tibiae, a frontal with antler, and aged teeth. F39 has an MNI of 1. All three of these pits contain head, torso, hindlimb, and forelimb elements in proportion to the MNI for the pit except for F35, which does not have clear forelimb bones, although it does have a number of undifferentiated limb bones in the form of tarsals, metatarsals, and phalanges.

Thus, based on body parts represented, the evidence indicates that the five deer in F38 and the one deer in F39 were transported to the site whole, while all or some of the deer in F35 probably came into the site whole, as well. None of the other sampled feature contexts where deer bones were recovered have more than two main deer body parts represented. F29 has the frontal with attached antler, and evidence of limb bones in the form of metatarsals, and lunates. Preservation in this pit was poor, and notably there were few shellfish. The exception is F33, the feature containing the male human burial, which has deer torso (in the form of pelvic bones), and both hindlimb and forelimb parts. The deer bones were recovered from the feature fill, indicating they likely used sheet midden soil from the adjacent surface dump for backfilling the burial.

Overall, approximately eight to nine out of a total sample of 21–22 deer were brought to the site whole. The transportation of whole animals raises questions of distance to source and consideration of the Schlepp effect, or how far hunters are likely to transport whole animals from the kill site (Daly 1969:151). An implication of the Schlepp effect is that minimally, some deer were harvested nearby. The Schlepp effect does not follow rigid rules, but adult male white-tailed deer weigh between 68–136 kg. Given this body size, a reasonable schlepp distance might be about 5km.

A sizable number of deer would have been available within five kilometers of the Brown's Bottom sites. Estimates of the deer herd size in Ohio within a catchment of a five kilometer radius (an area of 78.5 km^2) range between 300–1500 individuals (Shelford 1963:26–28; Shriver 1987; Starna and Relethford 1985:828). "Models that simulate a deer population under various harvest rates show that harvesting 70 percent of the antlered deer from a herd has little effect on population growth. Harvesting more than 25 percent of the does, however, can cause the population growth to decline" (Pierce et al. 2012). Accordingly, harvest rates of 30–35% of the local deer population are easily sustainable without population decline, supplying between approximately 100–500 deer per year/per five kilometer radius catchment. As will be noted again below, exploitation of sustainable deer harvests by dispersed Ohio Hopewell households is a key element of the settlement pattern (Pacheco and Dancey 2006:15–16).

Local spring harvests may have focused on the floodplain area near the sites because this is when the forest openings would have been prepared to grow the Eastern Agricultural Crops (EAC). These gardens (Wymer 1996, 1997), in addition to the young greens, would have created edge conditions drawing in deer, turkey, and raccoon; species which were also identified in the faunal remains of F38. Thus, hunting gardens in this time frame would have focused on animals concentrated in and around artificial edges, increasing predictability, and protecting crops.

Fall upland deer hunts are compelling for multiple reasons. Ripened nuts fallen to the ground attract deer, so groups looking to harvest deer in the fall would also have had an opportunity to collect nuts during deer hunts. Nutshell, not surprisingly, was also recovered in abundance at the Brown's Bottom sites (see Wymer, this volume). Additional support for the fall acquisition of upland resources comes from evidence of ephemeral Hopewell use of upland rock shelters across the core region for logistical satellite hunting camps as opposed to their use as seasonal bases (Seeman 1996).

Possible corroborating evidence for minimal transport distance for deer has been identified at BB#1 by researchers from Arizona State University using strontium isotope analysis of archaeological tooth samples (Knudson et al. 2011). Six deer, a beaver, and the two human remains were sampled from BB#1. Two distinct patterns were observed in the results. The beaver, four deer and both humans produced $^{87}Sr/^{86}Sr$ values ranging from 0.70881–0.71126, while two deer produced higher $^{87}Sr/^{86}Sr$ values of 0.719 and 0.72.

Unfortunately, extreme caution must be exercised when interpreting $^{87}Sr/^{86}Sr$ values in the Scioto Valley, as samples of water and calcareous tills from the entire valley stretching far north into the glaciated plateau produce strontium values in the lower range (Curtis and Streuber 1973; Steele and Pushkar 1973). As a result, where exactly in the Scioto Valley the BB#1 deer with lower strontium values were harvested is not directly discernible from the strontium results (Knudson et al. 2011:4–5). Strontium samples from tributaries and soils south of the maximum glacial advance, however, do produce somewhat higher values, although again caution is warranted. These higher strontium values reflect hinterland tributary or upland settings, especially in areas draining or underlain by clastic sedimentary rocks like shale (Curtis and Streuber 1973:173–174; Steele and Pushkar 1973:331, 338).

As previously discussed, the deer from F35 and F39 were harvested during fall hunts and some or all of them were transported to the site whole. Interestingly, it is the two samples from these pits (FS#37 and FS#112) which produced the highest strontium values, suggesting possible convergence of the strontium, seasonality,

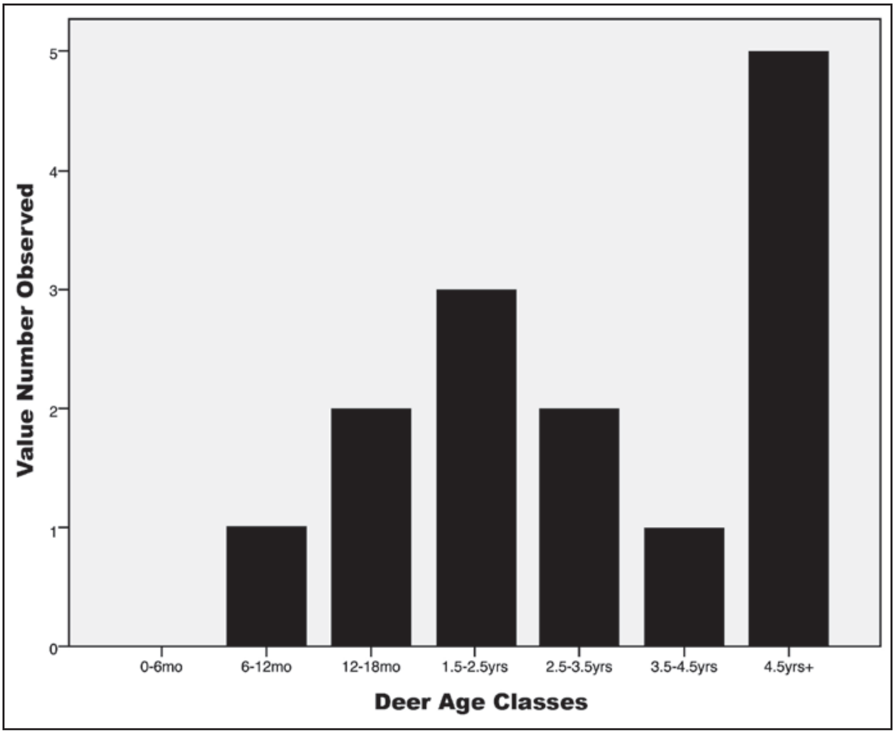

Figure 7. Deer age classes observed in BB#1 Ohio Hopewell features; N=13–14.

and deer body parts evidence. This convergence may even point to the particular uplands that the Brown's Bottom people were hunting as the ones directly west across the Scioto River. These uplands are notably just south of the glacial maximum boundary in an area of shale bedrock. It is possible to be deep into the upland hollows within 3–4 km of the site going in this direction. The Schlepp effect increases the plausibility of this scenario. From an energetic and practicality perspective, it would be much more difficult to transport whole deer from the unglaciated hill country 50 km east of the Scioto Valley, than it would be to transport them whole from across the river. Importantly, this interpretation is testable in the sense that modern deer from these hills can be analyzed for strontium values.

DEER HUNTING PATTERNS

The degree of hunting pressure being exerted on a deer herd, or any population of ungulates for that matter, can be understood by examining mortality profiles of the age at which the animals are harvested (Lyman 1987; Wolverton 2008). Unfortunately, the sample of deer with estimated ages from BB#1 is slightly less than half of the sample size of 30 individuals which Lyman (1987:138) indicates is necessary to conclusively document a pattern. This small sample size should be approached with caution and is unresolvable without additional excavations. Nevertheless, examination of the observed ages of deer harvested at BB#1 is worthwhile, since the observed pattern is so pronounced. Figure 7 shows that relatively few young deer were harvested, accounting for less than a third of the observed individuals. For this figure, given that the precise aging of older deer is difficult, all deer estimated to be 4.5–7 years old were lumped together.

The age of the harvested deer can also be measured indirectly by the size of the animals; however, little evidence for deer body size is available, except for seven measurable astragali (six right, one left). The length of this small sample ranges from 37–43 mm (average length=40.3 mm, sd=2.4 mm), while the width ranges from 23–27 mm (average width=25.1 mm, sd=1.6 mm). These astragali are significantly longer, by about 11 mm on average, and three millimeters wider on average, than large samples of both modern and prehistoric white-tailed deer from central Texas of all age classes (Wolverton et al. 2008). Without a comparative data set from Ohio, it is hard to know what these size differences mean, except to say that the white-tailed deer represented in the measured BB#1 sample tend to be large adults, possibly because many of them were bucks.

The BB#1 data strongly indicate an attritional hunting pattern (Lyman 1987:128). The pattern also indicates that hunting pressure is not high, implying that the underlying deer herd is stable, healthy, and not under stress (Wolverton 2008). Both catastrophic death assemblages and significant hunting pressure would be characterized by mortality profiles exhibiting a high frequency of young individuals. "An increase in harvest pressure shortens the average life span of prey by reducing the probability of survival as individuals age" (Wolverton 2008:182–183 following Caughley 1977). Similarly, as mortality increases as a result of harvest pressure, fertility remains stable or slightly increases, producing shorter average lifespans and juvenile-dominated population age structures which are old adult depleted (Caughley 1977).

For comparison, the Late Natufian hunters at Nahal Ein Gev II in the Levant were putting heavy pressure on the gazelle that they hunted: "...less than one quarter of the hunted animals were older than 18 months of age.... Although the residents of NEG II hunted few fawns, they hunted yearlings in proportions far greater than expected for a stable population (Grossman et al. 2016)." The pattern exhibited in the BB#1 data is so contrastive that even if additional specimens could be added to the sample, a significant majority of these individuals would have to be 18 months old or younger to drastically alter the pattern observed, thus increasing our confidence that the small sample observed at BB#1 is a reliable reflection of the actual deer hunting pattern.

Given the estimated low human population density of Ohio Hopewell communities in the central Scioto Valley (Carr 2008; Greber 1997; Pacheco and Dancey 2006), the deer hunting pattern observed at BB#1 suggests the likelihood of sustainable deer harvests. These data can also be interpreted as primary support for a position linking the deer hunting pattern to the settlement pattern:

> Ohio Hopewell populations were dispersed and sedentary because of their niche. Small reliable catchments favored sedentism, and the set of resources in them—especially the all-important deer—was best exploited by small dispersed groups organized at the scale of households [Pacheco and Dancey 2006:16].

Wymer (1996; 1997:161), following Asch and Asch (1985), has argued that this dispersed gardening pattern, centered as it was on the creation of forest openings for EAC garden spaces, would have synergistically improved local forage. Garden edges likely improved deer biomass, providing feedback in the niche to favor a dispersed settlement pattern, and in turn promoting the earthwork and mound building tradition (Pacheco and Dancey 2006).

The fragmentation of the deer bones at both Lady's Run and BB#1 presents an interesting contrast to the mortality profile. Both bone assemblages are highly fragmented, with Lady's Run the more fragmented of the two. The Lady's Run bones were exposed to weathering in the channel deposit, while the recovered BB#1 deer bones were deposited in pit features that were then filled by the site occupants. Wolverton et al. (2008:17) would categorize both of these assemblages as Class 3: high fragmentation. They argue that fragmentation represents an attempt to maximize utilization of in-bone nutrients in the form of marrow and that, "…intensity of fragmentation, or the degree to which specimens are fragmented, is relevant to efficiency of grease extraction as smaller fragments expose more surface area" (Wolverton et al. 2008:15). Thus, even though the mortality profile does not provide evidence for significant hunting pressure, there is some evidence that the Brown's Bottom Hopewell people were intensely and completely utilizing their deer resources. This fragmentation pattern may also reflect intensive utilization during winter months. One note of caution here in over-interpreting the fragmentation pattern is that the Brown's Bottom Hopewell people also had dogs who might have chewed up bones in the refuse.

An additional piece of evidence which supports intensive utilization is shown by the condition of the deer phalanges recovered from F35, F38, and F39 at BB#1. Eleven of thirteen, or 85% of these, were broken open for marrow extraction; only two were recovered whole. Notably, dog chewing did not cause the breakage patterns observed in the phalanges. Considering how small phalanges are in comparison to long bones, it suggests that deer marrow was considered a premium resource. Reconciliation of these contrasting approaches shows that perhaps both of these patterns of deer use—attritional use of healthy adults followed by complete utilization of resources—are outcomes of a sustainable Ohio Hopewell niche.

CONCLUSION

Overall, a relatively clear picture of seasonality emerges from looking at the Hopewell deer utilization patterns on Brown's Bottom. This pattern is reinforced by combining it with the evidence of plant use (see Wymer, this volume), other faunal resources, and structural evidence (Kanter et al. 2015) to create a composite view of seasonality evidence from the two sites (Table 10). Examination of the table presents a convincing case, cementing the interpretation that the Ohio Hopewell people who lived on Brown's Bottom were year-round occupants.

Table 10. Composite of All Ohio Hopewell Seasonality Evidence, Brown's Bottom #1 & Lady's Run Combined.

Spring (April–June)	Summer (July–September)	Fall (October–December)	Winter (January–March)
Onion Bulb	Squash	Nuts (Hazelnut, Hickory, Black Walnut, Butternut, Acorn)	Substantial Structures w/ Multiple Hearths
Maygrass/Honey Locust	Chenopod/Sumpweed/Little Barley/Tobacco	Pokeweed/ Sumac/ Wild Grape/Elderberry	Thermal Pits Under Benches—sleeping?
Shellfish	Shellfish	Knotweed/Sunflower	Storage Pits—Interior & Exterior
Turtles	Turtles	15–18 Month old Yearling Deer	10–11 Month old Deer Fawn
Deer Antler in Velvet (from floodplain?)	Black Raspberry	Deer Antlers with no Velvet (from uplands?)	Shed Deer Antlers

CODA

It is well past time to move on from the polarized debate about the mobility patterns and degree of sedentism exhibited by the Ohio Hopewell populations who made the great earthworks and mounds, as undoubtedley, mobility strategies always exist along a continuum and vary widely (Kelly 1991; Pacheco 2010). On the other hand, it is also time to reject the assertion that Ohio Hopewell people were mobile foragers (Yerkes 2002,2005, 2006). An integral part of Yerkes' claim is that excavated sites lack substantial dwellings, thick middens, remains of plants and animals obtained during different seasons, and deep storage pits, but there is no statement of how substantial, thick, or deep they must be. Instead, his position centers on repeatedley pointing out what is missing, rather than on fieldwork supporting the mobile foraging pattern. In contrast, a growing body of fieldwork has identified a repeated pattern of substantial dwellings, rich middens, seasonality, and food production at suggested dispersed Ohio Hopewell domestic sites (e.g., Blosser 1996; Burks 2004; Pacheco and Dancey 2006; Prufer 1965; Smith 1992; Wymer 1996; 1997). Yet, other scholars have followed Yerkes' lead of interpreting the Ohio Hopewell as mobile foragers; examples include Cowan's (2006) analysis of lithic technology and temporary earthwork accomodations, Byer's (2011) rich stucturalist logic, and those who uncritically cite him (e.g. Henry and Barrier 2016), without attempting to evaluate his arguments.

Our multi-stage research strategy on Brown's Bottom, which included geophysical prospecting, shows that part of the problem with past attempts to document candidates for Ohio Hopewell domestic sites, has been the inability of archaeologists to pinpoint features and structures for excavation. To quote Sallah from *Indiana Jones: Raiders of the Lost Ark,* they were "digging in the wrong place." This seems to be the case for at least some past research efforts, like Prufer's work at McGraw and Brown's Bottom 1, or Blosser's work at Jennison Guard, all of which focused almost exclusively on excavations in refuse deposits. Some sites, like Twin Mounds West (Hawkins 1996) might actually meet Yerkes demanding standards, but suffer from being poorly known and only partially published, while other sites like Marsh Run (Aument and Gibbs 1991), Decco (Phagan 1977), or 12FR310 (Niemel 2009) are limited to CRM reports, or less widely distributed journals (Nielmel 2010/2011). The Patton site (Weaver et al. 2011), on the other hand, contains the diverse kinds of evidence for a stable year round domestic occupation, but does not meet the "substantial" structure standard. Finally, the excavation strategy at the Murphy I site used machine stripping of the plow zone to obtain complete exposure of the sub-plow zone surface, but structural evidence appears to have been compromised by deep historic plow damage (Dancey 1991).

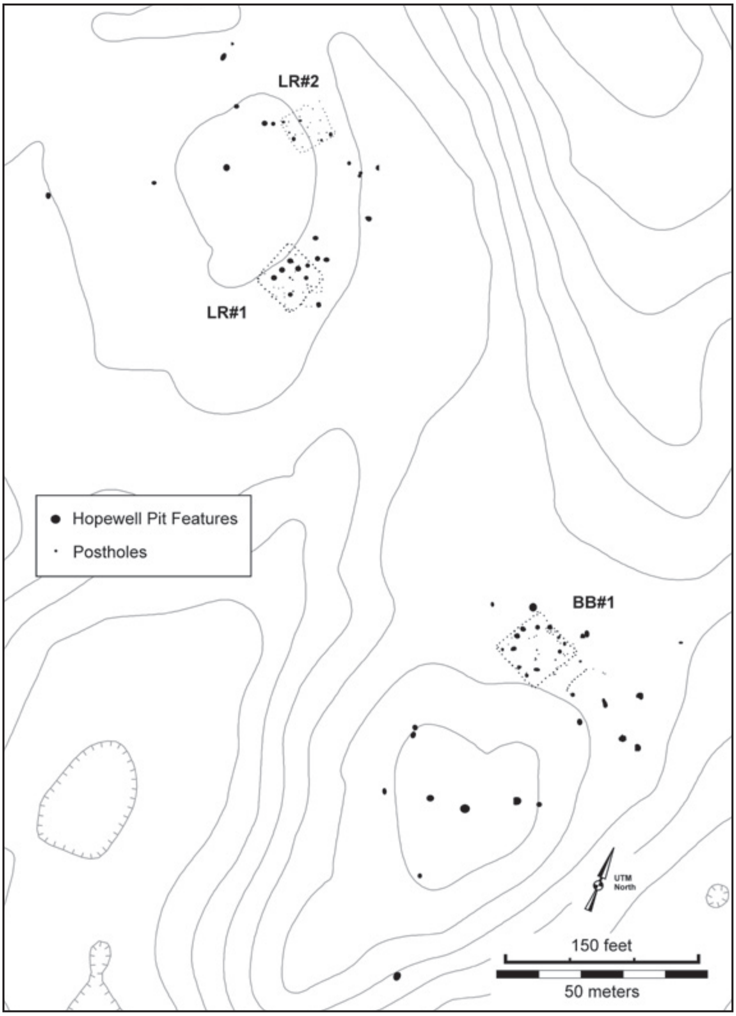

Figure 8. Overview map of 2005–2011 excavation results in Harness Field T showing relationship between Lady's Run and BB #1. Contour interval = 10 cm.

Our efforts on Brown's Bottom provide well documented complete structures, which by any standards, Eastern Woodlands or otherwise, are certainly substantial (Kanter et al. 2015). We also have documented numerous pit features, secondary refuse deposits, evidence of multi-season occupation, and storage pits. The call for this kind of evidence would seem well answered, but it remains to be seen if the goal posts will shift. Likewise, Griffin's (1996) admonition about a Hopewell housing shortage would seem to be fading, too. The Brown's Bottom sites are a solid match for the dispersed shifting Ohio Hopewell farmsteads Prufer (1965) posited over 50 years ago in his McGraw report.

In conclusion, an extensive literature (see for example Banning 2011; Burks 2004; Coupland and Banning 1996, Kelly 1991; Kent 1992; Kozarek 1997; Pacheco 2010; and Steadman 2015) supports the interpretation that the Brown's Bottom sites are the domestic settlements of stable, dispersed, year round, extended family households, fully engaged in food production (Wymer, this volume), possible symbolic and ritual elements notwithstanding, and whose mobility strategy was primarily logistical as opposed to residential. The similarity of the observed settlement pattern on Brown's Bottom (Figure 8) to the generalized model of the Ohio Hopewell niche in the core region which we envisioned prior to the project is noteworthy (Pacheco and Dancey 2006:Figure 1.5). Evidence from Brown's Bottom now suggests that this niche was sustainable as well.

The Ohio Hopewell people who lived on Brown's Bottom are no doubt part of the community who participated in building the great Liberty Earthworks, Harness "Big House," and other associated mounds on the terrace above the floodplain. Regardless of whether or not any parts of the occupations at BB#1 and Lady's Run were contemporaneous, that the Liberty Earthworks and mounds helped to integrate these dispersed populations, is the one area where all interpretations seem to converge. If our view is correct, these Brown's Bottom Hopewellians lived full-time on some of the most prime real estate in existence during the Middle Woodland period. Given their amazing cultural accomplishments, it should not really be a surprise that their domestic settlements are equally impressive.

ACKNOWLEDGMENTS

We want to extend our special thanks and appreciation to the late Robert L. Harness for his permission to work on his lovely farm. It was Bob's deep fascination with prehistory that really made the project possible. Most farmers in the Scioto Valley think archaeologists are a nuisance, but Bob recognized the importance of our work and its contribution to the legacy of the land his family came to steward. We very much appreciate the funds and support provided by Ohio Archaeological Council, Ohio Valley Archaeology, Inc., the SUNY Geneseo Research Council, and Bloomsburg University, as well as the Ball State–Kent State NSF sourcing study, co-directed by Kevin Nolan, Mark Hill, and Mark Seeman, for their expert analyses and for providing us with funds for new radiocarbon dates.

We also want to thank Sarah Wisseman, Thomas Emerson, and Randall Hughes for conducting the analysis on the Lady's Run platform pipe and the late N'omi Greber for facilitating the analysis. Jeff Dilyard also deserves special thanks for his help with the structural engineering analysis, during which he built by hand the scale model and took the photograph shown in Figure 5. Jeff Over from the SUNY Geneseo Geology Department graciously identified the stone used in the small bowl from Lady's Run.

We are very grateful for the chance to teach and work with all of our many students who participated in the 2005–2011 joint SUNY Geneseo-Bloomsburg University archaeological summer field schools. None of our research could have occurred without their enthusiastic and professional participation during the field work. All maps in this article were created by Jarrod Burks, assisted by Paul Pacheco. Errors here or in previous reports and publications are primarily the fault of Paul Pacheco trying to process and keep track of the vast amount of data we accumulated during the Brown's Bottom project. The numbers and data in this chapter supersede all preceding synthetic attempts, although no doubt, some of these will turn out to be wrong too.

NOTES

1. The pipe analysis is based upon work supported by the National Science Foundation under grant nos. 9971179 and 02–03010. The principal investigator is Sarah Wisseman, Director of the Program on Ancient Technologies and Archaeological Materials, University of Illinois, with co-principal investigators Thomas Emerson, Director, Illinois Transportation Archaeological Research Program, and Randall Hughes, Illinois State Geological Survey.

REFERENCES CITED

Aimers, James J. 2004. *Cultural Change on a Temporal and Spatial Frontier: Ceramics of the Terminal Classic to Early Postclassic Transition in the Upper Belize River Valley.* BAR International Series No.1325. British Archaeological Reports, Oxford, England.

Asch, Nancy B., and David L. Asch. 1985. Archaeobotany. In *Deer Track: A Late Woodland Village in the Mississippi Valley,* edited by C.R. McGimsey and M.D. Conner, pp. 44–117. Center for American Archeology, Kampsville, Illinois.

Aument, Bruce W., and Kevin Gibbs. 1991. *Phase III and Phase IV Data Recovery Survey of 33Fr895 and 33Fr901 on the Walmart Property in Grove C City, Franklin County, Ohio.* Report on file, Ohio Historic Preservation Office, Columbus.

Banning, Edward.B. 2011. So Fair a House: Göbekli Tepe and the Identification of Temples in the Pre-Pottery Neolithic of the Near East. *Current Anthropology* 52:619–660.

Bender, Sandra. 2011. Buried Secondary Refuse Deposits at the Lady's Run Site (33Ro1105): Implications for Ohio Hopewell Sedentism. Paper Presented at the Midwest Archaeology Conference, LaCrosse, Wisconsin.

Blank, John. 1965. The Brown's Bottom Site. *Ohio Archaeologist* 15(1):16–21.

Blosser, Jack. 1996. The 1984 Excavation at 12D29S: A Middle Woodland Village in Southeastern Indiana. In *A View from the Core: A Synthesis of Ohio Hopewell Archaeology,* edited by P. J. Pacheco, pp. 54–69. Ohio Archaeological Council, Columbus.

Burks, Jarrod D. 2004. *Identifying Household Cluster and Refuse Disposal Patterns at the Strait Site: A Third Century AD Nucleated Settlement in the Middle Ohio River Valley.* PhD dissertation, Department of Anthropology, Ohio State University, Electronic document, http//ohiolink.edu, accessed March 12, 2006.

Burton, Kelli W. 2006 Putting Down Roots. *American Archaeology* 10(3):33- 37.

Byers, A. Martin. 2011. *Sacred Games, Death, and Renewal in the Ancient Easterns Woodlands: The Ohio Hopewell System of Cult Sodalities.* Altamira Press, Lanham, Maryland.

Cain, Alan, and Mike Wallace. 2003. *A Guide to Age Determination of White-Tailed Deer.* Texas Parks and Wildlife, Austin, Texas.

Carr, Christopher. 2008. Settlement and Communities. In *The Scioto Hopewell and Their Neighbors,* edited by D. Troy Case and Christopher Carr, pp. 101–150. Springer, New York.

Caughley, Graeme. 1977. *Analysis of Vertebrate Populations*. John Wiley, New York.

Converse, Robert N. 1994. The Harness Hopewell Village Sites. *Ohio Archaeologist* 44(1):4–9.

Coughlin, Sean, and Mark F. Seeman. 1997. Hopewellian Settlements at the Liberty Earthworks, Ross County, Ohio. In *Ohio Hopewell Community Organization,* edited by William S. Dancey and Paul J. Pacheco, pp. 231–250. Kent State University Press, Kent, Ohio.

Coupland, Gary, and Edward B. Banning (editors). 1996. *People Who Live in Big Houses: Archaeological Perspectives on Large Domestic Structures.* Prehistory Press, Madison, Wisconsin.

Cowan, Frank. 2006. A Mobile Hopewell?: Questioning Assumptions of Ohio Hopewell Sedentism. In *Recreating Hopewell,* edited by Douglas K. Charles and Jane E. Buikstra, pp. 26–49. University Press of Florida, Gainesville.

Curtis, John B., and Alan M. Streuber. 1973. Sr/Sr Ratios and Total Strontium Concentrations in Surface Waters of the Scioto River Drainage Basin, Ohio. *The Ohio Journal of Science* 73(3):166–175.

Dalan, Rinita A. 2008. A Review of the Role of Magnetic Susceptibility in Archaeological Studies in the USA: Recent Developments and Prospects. *Archaeological Prospection* 15:1–31.

Daly, Patricia. 1969. Approaches to Faunal Analysis in Archaeology. *American Antiquity* 34(2):146–153.

D'Amico, Laura, and Paul J. Pacheco. 2008. Secondary Refuse Deposits and the Case for Ohio Hopewell Sedentary Lifestyles. Paper presented at the 75th Annual Meeting of the Eastern States Archaeological Federation, Lockport, New York.

Dancey, William S. 1991. A Middle Woodland Settlement in Central Ohio: A Preliminary Report of the Murphy Site. *Pennsylvania Archaeologist* 61:37–72.

Flinn, Emily, Robert A. Pierce, and Jason Sumners. 2012. Antler Development in White-tailed Deer: Implications for Management. http://extension.missouri.edu/p/G9486, accessed March 17, 2016.

Ford, Richard I. 1979. Gathering and Gardening: Trends and Consequences of Hopewell Subsistence Strategies. In *Hopewell Archaeology: The Chillicothe Conference,* edited by David S. Brose and N'omi B. Greber, pp. 234–238, Kent State University Press, Kent, Ohio.

Fortier, Andrew C., Thomas O. Maher, Joyce A. Williams, Michael C. Meinkoth, Kathryn E. Parker, and Lucretia S. Kelly. 1989. *The Holding Sit: A Hopewell Community in the American Bottom.* American Bottom Archaeology, FAI-270 Site Reports, Vol. 19. University of Illinois Press, Urbana.

Greber, N'omi B. 1983. *Recent Excavations at the Edwin Harness Mound, Liberty Works, Ross County, Ohio.* Special Publication 5, Midcontinental Journal of Archaeology, Kent State University Press, Kent, Ohio.

———. 1997 Two Geometric Enclosures in the Paint Creek Valley: An Estimate of Possible Changes of Community Patterns Through Time. In *Ohio Hopewell Community Organization,* edited by William S. Dancey and Paul. J. Pacheco, pp.207–229. Kent State University Press, Kent, Ohio.

Greber, N'omi B., Richard S. Davis, and Anne S. DuFresne. 1981. The Micro-component of the Ohio Hopewell Lithic Technology: Bladelets. *Annals of the New York Academy of Sciences* 376:489–528.

Griffin, James B. 1996. The Hopewell Housing Shortage in Ohio, AD 1–350. In *A View from the Core: A Synthesis of Ohio Hopewell Archaeology,* edited by Paul J. Pacheco, pp. 4–15. Ohio Archaeological Council, Columbus.

Grossman, Leore, Natalie D. Munro, Itay Abadi, Elisabetta Boaretto, Dana Shaham, Anna Belfer-Cohen, and Ofer Bar-Yosef. 2016. Nahal Ein Gev II, a Late Natufian Community at the Sea of Galilee. *PLoS ONE* 11(1): e0146647. DOI:10.1371/journal.pone.0146647, accessed March 19, 2016.

Hawkins, Rebecca A. 1996. Revising the Ohio Middle Woodland Ceramic Typology: New Information from the Twin Mounds West Site. In *A View from the Core: A Synthesis of Ohio Hopewell Archaeology*, edited by Paul J. Pacheco, pp. 70–91. Ohio Archaeological Council, Columbus.

Henry, Edward R., and Casey R. Barrier. 2016. The Organization of Dissonance in Adena-Hopewell Societies of Eastern North America. *World Archaeology* 48(1):87–109.

Hill, Mark A., Mark F. Seeman, Kevin C. Nolan, and Laure Dussubieux. 2018. An Empirical Evaluation of Copper Procurement and Distribution: Elemental Analysis of Scioto Valley Hopewell Copper. *Anthropological and Archaeological Science* 10(5):1193–1205.

Kanter, Noah, Paul J. Pacheco, Renato Perucchio, and Jarrod Burks. 2015. Living Large on the Bottom: A Structural Engineering Analysis of Three Ohio Hopewell Structures from Brown's Bottom, Ross County, Ohio. In *Building the Past: Recent Research on Prehistoric Wooden Post Architecture in Ohio*, edited by Brian G. Redmond and Robert A. Genheimer, pp. 146–187. University Press of Florida, Gainesville.

Kelly, Robert L. 1991. Mobility/Sedentism: Concepts, Archaeological Measures, and Effects. *Annual Review of Anthropology* 21:43–66.

Kent, Susan. 1992. Studying Variability in the Archaeological Record: An Ethnoarchaeological Model for Distinguishing Mobility Patterns. *American Antiquity* 57(4):635–660.

Knudson, Kelly J., Emily Schach, and Christopher Carr. 2011. Preliminary Report on Biogeochemical Analysis of Archaeological Human and Faunal Remains from Hopewell Sites. Unpublished report on file, Department of Anthropology, SUNY Geneseo, Geneseo, New York.

Kozarek, Susan E. 1997. Determining Sedentism in the Archaeological Record. In *Ohio Hopewell Community Organization,* edited by William S. Dancey and Paul. J. Pacheco, pp. 131–152. Kent State University Press, Kent, Ohio.

Lyman, R. Lee. 1987. On the Analysis of Vertebrate Mortality Profiles: Sample Size, Mortality Type, and Hunting Pressure. *American Antiquity* 52(1):125–142.

Mills, William C. 1907. The Exploration of the Edwin Harness Mound. *Ohio Archaeological and Historical Quarterly* 15:45–136.

Morris, Zoe H. 2015. Reconstructing Subsistence Practices of Southwestern Ontario Late Woodland Peoples (AD 900–1600) Using Stable Isotopic Analyses of Faunal Material. PhD dissertation, Graduate Program in Anthropology, University of Western Ontario, Electronic Thesis and Dissertation Repository, Paper 2921. http://ir.lib.uwo.ca/etd, accessed, March 19, 2016.

Nielmel, Karen S. 2009. *Phase III Archaeological Evaluation of Site 12Fr310 for the Rockies Express Pipeline-East (REX EAST) Project, Franklin County, Indiana*. Gray & Pape, Cincinnati, Ohio.

———. 2010/2011 Middle Woodland Community Organization in the Whitewater River Basin. *Indiana Archaeology* 5(2):109- 126.

Nolan, Kevin C., Mark F. Seeman, and Mark A. Hill. 2017. New Dates on Scioto Hopewell Sites. *Current Research in Ohio Archaeology 2017,* https://www.ohioarchaeology.org, accessed December 1, 2017.

Pacheco, Paul J. 2010. Why Move? Ohio Hopewell Sedentism Revisited. In *Hopewell Settlement Patterns and Symbolic Landscapes,* edited by A. Martin Byers and DeeAnne Wymer, pp. 37–55. University Press of Florida, Gainesville.

Pacheco, Paul J., Jarrod Burks, and DeeAnne Wymer. 2005. Investigating Ohio Hopewell Settlement Patterns in Central Ohio: A Preliminary Report of Archaeology at Brown's Bottom #1 (33Ro21). *Current Research in Ohio Archaeology 2005,* https://www.ohioarchaeology.org, accessed March 4, 2006.

———. 2009a. The 2006 Archaeological Investigations at the Brown's Bottom #1 Site(33RO1104). *Current Research in Ohio Archaeology 2009,* https://www.ohioarchaeology.org, accessed March 18,2009.

———. 2009b. The 2007–2008 Archaeological Investigations at the Lady's Run Site(33RO1105). *Current Research in Ohio Archaeology 2009,* https://www.ohioarchaeology.org, accessed August 18, 2009.

Pacheco, Paul J. and William S. Dancey. 2006. Integrating Mortuary and Settlement Data on Ohio Hopewell Society. In *Recreating Hopewell,* edited by Douglas K. Charles and Jane E. Buikstra, pp. 3–28. University Press of Florida, Gainesville.

Parmalee, Paul W. 1965. The Vertebrate Fauna. In *The McGraw Site: A Study in Hopewellian Dynamics.* Scientific Publications n.s. 4(1):115–118, Cleveland Museum of Natural History, Cleveland, Ohio.

Phagan, Carl J. 1977. *Intensive Archaeological Survey of the S.R. 315 Wastewater Treatment Facility Location Known as the DECCO-1 Site (33Dl28).* Progress Report submitted to the Board of County Commissioners, Delaware County, Ohio. Report on file, Ohio Historic Preservation Office, Columbus.

Pierce, Robert A. II, Emily Flinn, and Jason Sumners. 2012. *Estimating Deer Populations on Your Property: Populations Dynamics.* University of Missouri Extension, https://extension2.missouri.edu/G9488, accessed October 30, 2018.

Pi-Sunyer, Oriol. 1965. The Flint Industry. In *The McGraw Site: A Study in Hopewellian Dynamics.* Scientific Publications n.s. 4(1):60- 89. Cleveland Museum of Natural History, Cleveland, Ohio.

Prufer, Olaf H. 1963. Copies of unpublished field notes on excavations at Brown's Bottom. Manuscript on file, Department of Anthropology, SUNY Geneseo, New York.

———. 1964. Excavation at the Brown and McGraw Sites, Near Chillicothe, Ohio. *Ohio Archaeologist* 14(1):5–7.

———. 1965. *The McGraw Site: A Study in Hopewellian Dynamics.* Scientific Publications, n.s. 4(1). Cleveland Museum of Natural History, Cleveland, Ohio.

———. 1967. The Scioto Valley Archaeological Survey. In *Studies in Ohio Archaeology,* edited by O. H. Prufer and D. H. Mackenzie, pp. 267–328. Kent State University Press, Kent, Ohio.

———. 1968. *Ohio Hopewell Ceramics: An Analysis of the Extant Collections.* Anthropological Papers 33. Museum of Anthropology, University of Michigan, Ann Arbor.

———. 1996 Core and Periphery: The Final Chapter. In *A View from the Core: A Synthesis of Ohio Hopewell Archaeology*, edited by Paul J. Pacheco, pp.406–423. Ohio Archaeological Council, Columbus.

Prufer, Olaf H., and Douglas McKenzie. 1965. Ceramics. In *The McGraw Site: A Study in Hopewellian Dynamics*. Scientific Publications n.s. 4(1):18–59. Cleveland Museum of Natural History, Cleveland, Ohio.

Robertson, Robin. 1983. Functional Analysis and Social Process in Ceramics: The Pottery from Cerros, Belize. In *Civilization in Ancient America*, edited by R. M. Leventhal and A. Kolata, pp. 105–142. University of New Mexico Press, Albuquerque.

Ruby, Bret. J., Chris Carr, and Douglas K. Charles. 2005. Community Organizations in the Scioto, Mann, and Havana Hopewellian Regions. In *Gathering Hopewell: Society, Ritual, and Ritual Interaction,* edited by Christopher Carr and D. Troy Case, pp. 119–176. Kluwer Academic, Plenum, New York.

Scuilli, Paul S. 2005. Human Skeletal Remains from the 2005 Excavation of the Brown's Bottom #1 Site. Unpublished report on file, Department of Anthropology, SUNY Geneseo, Geneseo, New York.

Seeman, Mark F. 1992. The Bow and Arrow, the Intrusive Mound Complex, and a Late Woodland Jack's Reef Horizon in the Mid-Ohio Valley. In *Cultural Variability in Context,* edited by M.F. Seeman, pp. 41–51. Special Paper 7. Midcontinental Journal of Archaeology, Kent State University Press, Kent, Ohio.

———. 1996. The Ohio Hopewell Core and Its Many Margins: Deconstructing Upland and Hinterland Relations. In *A View from the Core: A Synthesis of Ohio Hopewell Archaeology,* edited by Paul J. Pacheco, pp.304–315. Ohio Archaeological Council, Columbus.

Seeman, Mark F., and William S. Dancey. 2000. The Late Woodland Period in Southern Ohio: Basic Issues and Prospects. In *Tradition and Transformation Across the Midcontinent*, edited by Thomas E. Emerson, Dale L. McElrath, and Andrew C. Fortier, pp.545–573. University of Nebraska Press, Lincoln.

Seeman, Mark F., and Frank Soday. 1980. The Russell Brown Mounds: Three Hopewell Mounds in Ross County, Ohio. *Midcontinental Journal of Archaeology* 5:73–116.

Shelford, Victor. 1963. *The Ecology of North America.* University of Illinois Press, Urbana.

Shriver, Phillip R. 1987. Ohio's White-Tailed Deer and Other Protohistoric and Historic Game Animals. *Ohio Archaeologist* 37:29–33.

Smith, Bruce D. 1992. Hopewellian Farmers of Eastern North America. In *Rivers of Change: Essays on Early Agriculture of Eastern North America*, by Bruce D. Smith, pp. 201–248. Smithsonian Institution Press, Washington, DC.

Snyder, Daniel, Michael Powers, Paul J. Pacheco, and Jarrod Burks. 2008. Brown's Bottom #1 (33RO1104) Bladelet Assemblage: An Experiment in Use-Wear Analysis. *Pennsylvania Archaeologist* 78(1):41–60.

Squier, Ephraim G., and Edwin H. Davis. 1848. *Ancient Monuments of the Mississippi Valley.* Smithsonian Contributions to Knowledge Vol. 1. Smithsonian Institution, Washington, DC.

Stafford, Barbara D., Mark B. Sant, and David L. Ash. 1985. *Smiling Dan: Structure and Function at a Middle Woodland Settlement in the Lower Illinois Valley.* Center for American Archeology, Kampsville, Illinois.

Starna, William A., and John H. Relethford. 1985. Deer Densities and Population Dynamics: A Cautionary Note. *American Antiquity* 50:825–832.
Steadman, Sharon R. 2015. *Archaeology of Domestic Architecture and the Human Use of Space.* Left Coast Press, Walnut Creek, California.
Steele, John D., and Paul Pushkar. 1973. Strontium Isotope Geochemistry of the Scioto River Basin and the Sr/Sr Ratios of the Underlying Lithologies. *Ohio Journal of Science* 73(6):331–338.
Stuiver, Minze, and Paula J. Reimer. 1993. Extended 14C Data Base and Revised Calib 3.0 14C Age Calibration Program. *Radiocarbon* 35(1):215–230.
Weaver, Sarah A., Elliot M. Abrams, AnnCorinne Freter, and Dorothy Sack. 2011. Middle Woodland Domestic Architecture and The Issue of Sedentism: Evidence from The Patton Site (33AT990), Hocking Valley, Ohio. *Journal of Ohio Archaeology* 1:22–40. Ohio Archaeological Council, Electronic document, http://www.ohioarchaeology.org.
Wolverton, Steve. 2008. Harvest Pressure and Environmental Carrying Capacity: An Ordinal-Scale Model of Effects on Ungulate Prey. *American Antiquity* 73(2):179–199.
Wolverton, Steve, Lisa Nagaoka, Julie Densmore, & Ben Fullerton. 2008. White-tailed Deer Harvest Pressure & Within-bone Nutrient Exploitation During the Mid- to Late Holocene in Southeast Texas. *Before Farming* 2:1–23.
Wymer, DeeAnne. 1996. The Ohio Hopewell Econiche: Human Land Interaction in the Core Area. In *A View from the Core: A Synthesis of Ohio Hopewell Archaeology,* edited by Paul J. Pacheco, pp. 36–52. Ohio Archaeological Council, Columbus.
———. 1997 Paleoethnobotany in the Licking River Valley, Ohio: Implications for Understanding Ohio Hopewell. In *Ohio Hopewell Community Organization,* edited by William S. Dancey and Paul J. Pacheco, pp.153–171. Kent State University Press, Kent, Ohio.
Yerkes, Richard W. 2002. Hopewell Tribes: A Study of Middle Woodland Social Organization in the Ohio Valley. In *The Archaeology of Tribal Societies,* edited by William Parkinson, pp. 227–245. International Monographs in Prehistory, Archaeological Series 15. Ann Arbor, Michigan.
———. 2005 Bone Chemistry, Body Parts, and Growth Marks: Evaluating Ohio Hopewell and Cahokia Mississippian Seasonality, Subsistence, Ritual and Feasting. *American Antiquity* 70(2):241–265.
———. 2006 Middle Woodland Settlements and Social Organization in the Central Ohio Valley: Were the Hopewell Really Farmers? In *Recreating Hopewell,* edited by Douglas K. Charles and Jane E. Buikstra, pp. 50–61. University Press of Florida, Gainesville.